2 OCTOBER 1959

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

ONE SHILLING

A

Electrical Aids in Industry *Data Sheet* **No.7**

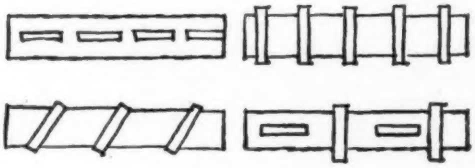
Lighting - 2

The general principles of factory lighting have been dealt with in the previous data sheet (No. 6). This one considers briefly certain factors—not always fully appreciated — that influence the lighting for some particular factory applications. The next data sheet will carry the subject further.

Work benches

The most universal application of lighting is to bench work, for there is no branch of manufacturing that does not have its work benches which, of necessity, are used for a great variety of occupations. No single lighting method is suitable for all cases.

The introduction of fluorescent lighting has gone a long way to solving one of the main problems here; for while the high degree of brightness of filament lamps tends to preclude their use for individual lighting owing to the glare, the fluorescent tube with its greater expanse of light source has made localised lighting with a low mounting height more practicable. Moreover, the length of the fluorescent tube puts into the hands of the designer a means of controlling shadows which, together with glare, probably represent the most prolific causes of errors and eye-strain.



With narrow individual benches (not more than 4 ft. wide), there are four basic methods of localised lighting: longitudinal, transverse, diagonal or a combination of longitudinal and transverse. With wider benches it is not advisable to use fittings directly over benches, and fittings should be behind the workers at each edge of the bench. Where particularly high illumination is required, fluorescent fittings may be mounted as local lights—low enough for the skirt of the reflector to conceal the lamps from the eye of the operator.

It is good practice to use reflectors which allow a reasonable amount of light to spill upwards, giving a certain amount of general lighting.

High-bay shops

Probably the most difficult of all factory lighting problems is that of high-bay lighting. In lofty, long and sometimes necessarily dirty shops such as those which house really large machine tools and overhead cranes, which do their worst to defy the efforts of the illuminating engineer, it requires great ingenuity, coupled frequently with high lamp wattage, to provide the workman with enough light to allow him to do his job efficiently. From the planer operator to the slinger, the workman, though he may not know it, is dependent on good lighting if he is to avoid an over-cut or a serious crane mishap.

CUT HERE

The major problems associated with the lighting of high and relatively narrow shops, such as heavy machine shops and foundries, are :—

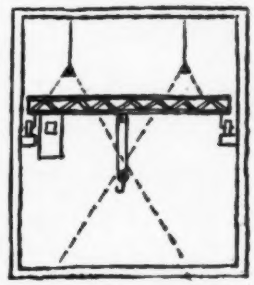
(a) Poor light utilisation caused by excessive light absorption by the large and often dark wall area.

(b) Preponderance of light flux downwards and poor cross lighting causing poor illumination on vertical surfaces, and heavy shadows.

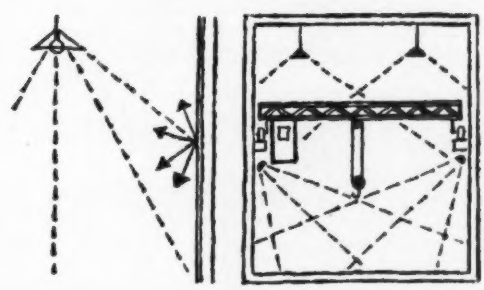
(c) Possibility of heavy light absorption in the atmosphere.

(d) Difficulty of access to high fittings for maintenance.

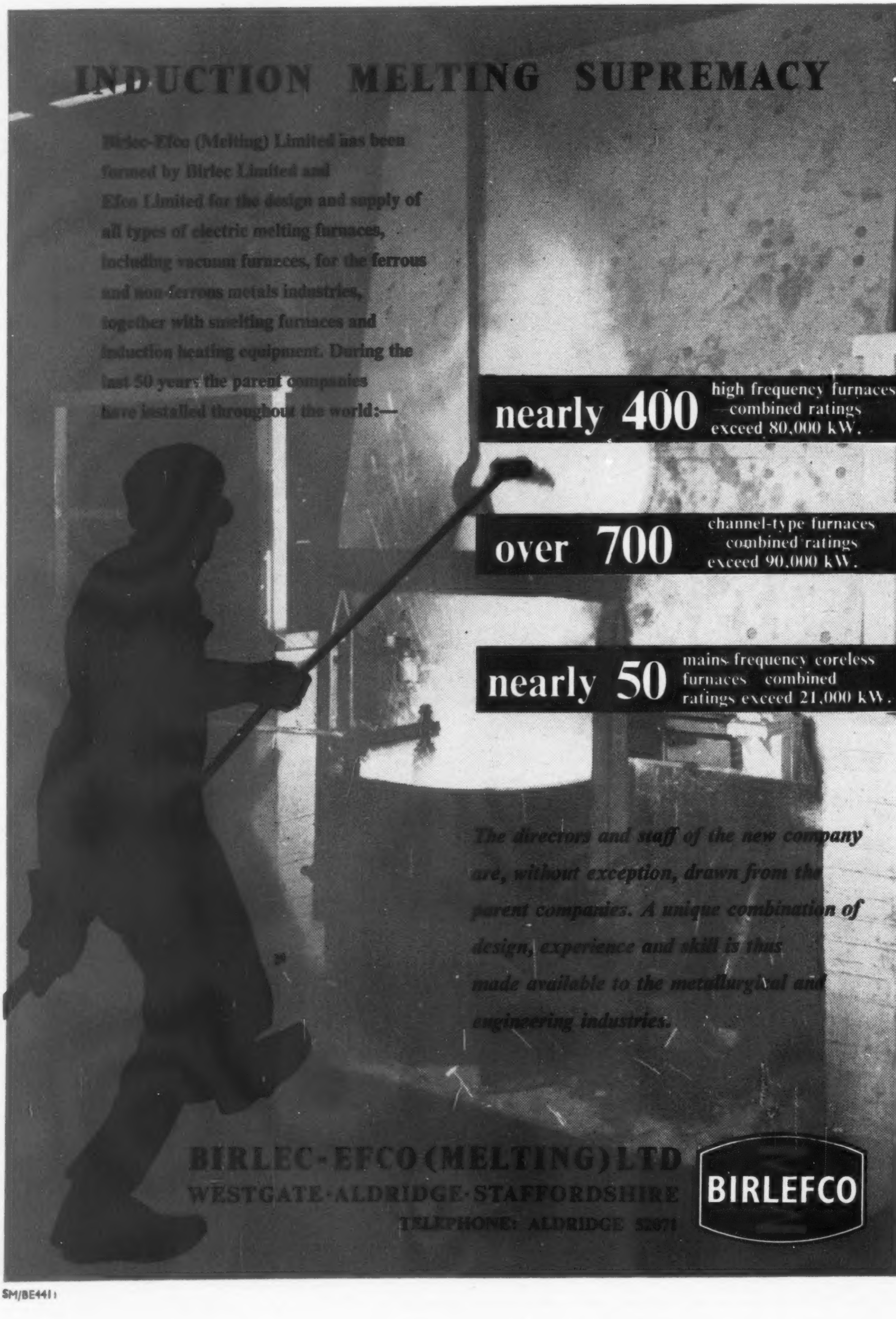
In high-bay workshops there is a tendency to use concentrating fittings so that the maximum proportion of the light output reaches the working area without spread to the walls, but the saving in wall absorption is obtained only by accepting a depressing environment, poor cross lighting and heavy shadows.



In many cases it is good practice to accept the inevitable reduction in light utilisation by wall absorption and to reduce this by applying light colours to interior surfaces where possible throughout. This approach results in more cheerful conditions and provides equally good illumination values and better cross lighting. Even better is to add angled lighting from the sides below crane level.



In the conditions obtaining in this type of shop, rapid deterioration in light source intensity due to dust must be expected. Facilities should always be provided for easy access to fittings for cleaning and maintenance.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METAL INDUSTRY

VOLUME 95 NUMBER 8 2 OCTOBER 1959

Trade with Ghana

SOME details of the many opportunities for United Kingdom manufacturers in Ghana, and the tremendous scheme of development which is planned for that country, are given in an interesting article which Mr. R. W. B. Carter, the U.K. Trade Commissioner at Accra, has contributed to a recent issue of the *Board of Trade Journal*. Ghana has often been described as an "underdeveloped country," but it is to-day a fast developing country, and its modernization is proceeding rapidly. A second development plan has now been approved and is spread over the period from July 1 this year to June 30 1964. Total expenditure under this plan is to be £G.350 million. Of this sum, £G.100 million is set aside for hydro-electric works. The remaining £G.250 million is divided into two sections—projects for "immediate implementation" to the value of £G.147 million, and projects which are to be deferred for the present, but tackled as opportunity permits, which account for the remaining £G.103 million. These latter are unlikely to be reached during the five-year period. The whole plan, though far-reaching and ambitious, does not seem to be beyond Ghana's powers. Mr. Carter considers that if a significant part of this plan is achieved it will change the face of the country.

The sum set aside for hydro-electric works, of which the most important is the dam across the Volta River, is expected to be raised in the form of external loans. Great importance is attached by the Government to the completion of the Volta Dam, and every effort will be made to achieve it. The primary purpose of the Dam, which is to be built at a site slightly downstream from that hitherto favoured, is the production of power. It is hoped that new industry, including an aluminium smelter, will be attracted to Ghana when this power is available. This Volta project involves contracts for the main construction, and for various lesser projects including power stations, road making, the supply of electrical machinery, cables, as well as the wide range of subsidiary equipment required for projects of this kind. Under the Second Plan, a target of some 600 new industries has been set and, in a number of these, agreements between industrialists and the Ghana Government have already been reached; in fact, in some cases construction of the necessary factories has already commenced. Among industries which have been, and still are, under discussion are included vehicle assembly, building materials, aluminium products, metal processing, radio assembly, metal screws, steelworks, varnishes and lacquers, etc.

A sum of £G.10 million is being set aside for direct Government investment in industrial enterprises and in preparation for this industrial expansion, and to help to attract investment, the Government last year streamlined its procedure for dealing with would-be investors in new industries for the country. A special drive is also to be undertaken to widen and improve the standard of technical education, and a large sum of money is to be spent on the establishment and improvement of technical and trade institutes, and the expansion of the existing College of Technology. A wide and varied range of engineering and other products will be called for to equip the new factories envisaged, and of instructional equipment for the expanding technical schools. All these projects for their completion will require many products, and the country looks to British manufacturers to supply them. There is no doubt that this great industrial expansion in Ghana offers to us in the United Kingdom an opportunity to add to the improvement of our economic position and the addition of a new market for our goods.

Out of the
MELTING POT

Active Control

AT an early stage in the history of craftsmanship, uncertainties of climate led to metal-working operations, as well as many others, being taken indoors and away from the immediate reach of the weather. Following this step, such processes could be carried out in an atmosphere from which, apart from "room temperature," pressure, humidity, and miscellaneous airborne impurities, the more extreme climatological variables had been eliminated. This indoor "weather" suited the vast majority of processes of cold working metals. Here and there, however, it was noticed that the control over this "weather" provided by a roof and four walls of a factory building was inadequate. The "room temperature," for example, did not remain sufficiently constant for the successful cold rolling of the finest gauges of strip. Dust and other airborne impurities were found to be undesirable in this connection as well as in the production of metals of the highest degree of purity and in the manufacture of products from such highly refined metals. These undesirable effects were eliminated by carrying control of the "weather" a stage further by the introduction of air-conditioning comprising the removal of dust, the control of temperature, and in some cases of the humidity. A still more advanced stage has now been reached in a development in which temperature is not merely controlled as a constant factor of a cold working process, but is actively varied to produce a desired effect. The particular effect is the achievement of gauge uniformity across the width of cold rolled strip. This is achieved by controlling the temperature across the face of the top roll of a cold finishing mill, for which purpose a number of radiant heat gas burners are spaced across the roll, the heat input to the roll being controlled, as required, to expand low spots on the roll. By this means, the strip can be kept within 0·0002 in. of the nominal gauge. Nice weather we are having.

Not Literally

WHAT a pity it is that one's doubts about other people's grammar (regardless of any shortcomings in one's own) invariably intervene to cast doubt on the literalness of statements which, otherwise, would be calculated to conjure up the most intriguing visions. Take, for example, the announcement that: "non-electrolytic, non-fuming chromate conversion coatings that operate at room temperature on zinc, cadmium, aluminium and magnesium have been developed by . . . ." But then, a chromate conversion coating could hardly be expected to fume while operating on one of the above metals, though somebody ought surely to have fumed at this statement.

"Cuppa"

"TWO for each person and one for the pot", or whatever your pet formula happens to be, may have been all very well in the days before inventors set out to improve, like everything else, the making of tea. A preferred method of preparing an extract of tea leaves now comprises "extracting the leaves in an equilibrium batch-wise counter-current process having two to three stages in which the fresh leaves are introduced at the initial stage and fresh water at the final stage, contacting partially spent tea leaves with said fresh water in the final stage to produce an aqueous extract, passing the extract in contact with fresh leaves in the initial stage to obtain a completed extract, maintaining the temperature of the final stage at about 200° to 250°F., maintaining the temperature of the initial stage at about 80° to 175°F., maintaining the ratio of the total amount of fresh water introduced at the final stage within the range from about 9:1 to about 13:1, pressing the leaves after each stage to expel absorbed and occluded extract therefrom before extracting the leaves in the next subsequent stage and recovering said expelled extract, and withdrawing from the initial stage a completed extract having at least 2·5 per cent soluble tea solids and containing at least about 80 per cent of the soluble tea solids in the leaves". How do you like it?

Controlled Simplicity

THERE are two basic ways in which an experienced, skilled machinist can be replaced. One way is to break down his job into some convenient number of operations, each one sufficiently simple to be performed by a relatively unskilled operator. The other way is to develop some highly complicated automatic machine, controlled, perhaps, by punched cards, a magnetic tape recording or a computer, to take over so far as possible the whole of the skilled job. There are, of course, various intermediate half-way solutions that depend on providing semi-automatic machines operated by less highly-skilled machinists. Generally speaking, however, the two trends are those indicated. The mechanical alternative to the highly "skilled" automatic machine has received little consideration. The alternative to a tape- or computer-controlled equivalent of an experienced, highly skilled machinist is the production line, with the simplest possible operations being performed at the various stations by the mechanical equivalents of unskilled workers under centralized control by tape, punched cards or computer. Such a solution permits the maximum advantage to be taken of existing control means and automatic transfer equipment. The use of a single elaborate "electronic brain" to control the operations of a large number of the simplest possible machine tools along a production line appears to be a more logical arrangement than the combination of a complex near-automatic, multi-purpose machine incorporating an "electronic brainlet" to take care of any minor shortcomings. The fully-mechanized production line also provides the answer to the vexed question of standardization in the manufacture of machine tools. Standardization in this field can receive little more than lip service where the trend is towards more and more complicated machines. The simple machines for performing simple basic operations along a production line, on the other hand, would be required in such large numbers as to make their standardization really worthwhile. There would also be the advantage of being able to arrange for extensive product modifications by changing tapes or punched cards in the central control equipment, instead of having to install new special-purpose machine tools.

Skimmer

CLEANING — FLUXING — STOPPING-OFF — BRAZING

Brazing Aluminium Alloys

II—PRACTICE

WHICHEVER of the three processes is used for brazing aluminium—flame, furnace or flux-dip—it consists of six stages: cleaning, fluxing, stopping-off, brazing, flux removal and finishing.

As with the brazing of other metals, the best results can only be achieved when the surfaces to be brazed are clean and free from grease. The amount of cleaning, which naturally depends on surface condition, is usually determined by trial. Components should preferably be cleaned and dried before assembly to reduce the likelihood of cleaning fluid becoming trapped in joints.

Cleaning

For flame brazing, degreasing may be necessary, or chemical cleaning, the latter for some assemblies leading to more efficient production. It is often sufficient to reduce the amount of oxide film by using steel wool or a wire brush, then wiping with a clean rag.

For furnace and flux-dip brazing an ordinary trichloroethylene vapour or liquor degrease, followed by chemical cleaning to provide an etched surface, is usually necessary. The chemical etch provides a roughened surface which promotes the flow of brazing alloy by capillary attraction. Etching may sometimes be omitted on new stock from the manufacturer or other sources provided that it is in good surface condition.

There are three common cleaning solutions, one of which consists of 2 per cent by weight of sodium hydroxide and 5 per cent by weight of sodium silicate solution in water; in this case, the bath temperature is 90°C. and the immersion period about 1½ min. The second contains 5 per cent by weight of anhydrous sodium carbonate solution in water; it has the same bath temperature as the previous solution, but the immersion time is only 30 sec. The third solution consists of 1 per cent by volume of hydrofluoric acid; the bath temperature is ordinary room temperature and the immersion period 1 min.

The second of these solutions is more active than the first and is mainly used for heavily-oxidized surfaces. The third solution is used after degreasing, but its use enables the nitric acid neutralizing dip, mentioned later, to be omitted. The use of hydrofluoric acid involves considerable hazards to health, making protective clothing essential.

Immediately after chemical cleaning, parts must be thoroughly washed in water and then—except when using the third solution—dipped into a 15 per cent solution of cold nitric acid for about 1½ min. to neutralize any remaining alkali, followed immediately by a rinse in hot water. Thorough rinsing is essential after cleaning, to remove all traces of acid and other residual salts which might prevent brazing. In cases where the aluminium surface may have been contaminated with copper-base alloys, the nitric acid treatment should be prolonged to ensure the complete removal of all particles of copper, as these form low melting point constituents capable of penetrating deeply into the parent metal and causing pitting during brazing.

Methods of assembly or handling after cleaning must be such as to prevent the re-contamination of parts: even finger-marking is extremely undesirable, especially when furnace brazing. The period between cleaning and brazing must, therefore, be kept to a minimum. In general, the exact degree of cleaning necessary can be governed by individual shop practice and conditions. The use of extra flux to compensate for inadequate cleaning may be effective on occasion, but it is not efficient, nor does it make for good work, and should thus be discouraged.

Fluxing

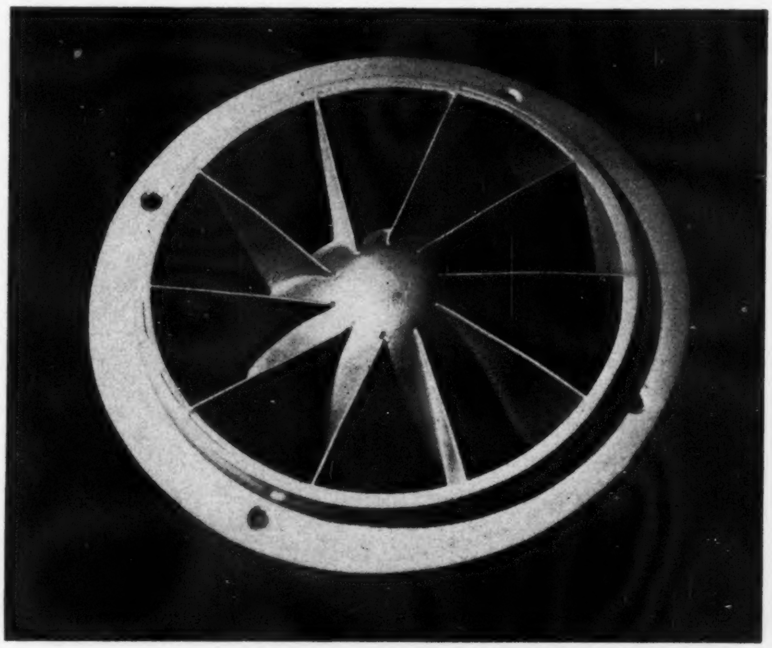
Flux is normally supplied as dry powder in an airtight container or as a liquid. The powder is usually used dry, as a suspension mixture or paste in distilled water or alcohol. Alcohol adds to the cost, but produces a quick-drying mixture and obviates the risk of producing hydrogen, which would adversely affect the joint properties. As the fluxes are hygroscopic, and chemical action may take place between the constituents in the flux if it becomes moist, only the amount needed for each mixing should be taken from the container. As a rule, not more than six hours' supply should be prepared at a time.

Wetting agents may be added to fluxes in quantities up to 0·1 per cent of the water content, but if an alcohol paste is used, this is unnecessary. Some fluxes already contain a wetting agent.

In flame brazing, the flux is often used dry, but only on small joints and where it is certain that the flux, in melting, will completely cover the mating surfaces. Otherwise, a thick, creamy flux paste which will not spread too easily during its initial application should be brushed over the filler metal and joint area. If too fluid, the flux, followed by the filler metal, may flow to locations where it is not required. A common method is to dip the end of the filler rod into the flux intermittently as brazing proceeds.

For efficient operation in furnace brazing, assemblies with components made largely of clad sheet are better

Dip-brazed impeller [*Courtesy Marston Excelsior Ltd.*



completely coated with flux, preferably applied by dipping in a mixture of one part of flux to one part of water, by weight. Flux may also be applied to areas to be brazed by brush or by spraying with a slightly thinner mixture. The weight of dry flux applied should be about ½ oz/ft². The flux coating must be dried as soon as possible to prevent attack on the metal surface, but not so rapidly as to impair its uniformity.

Wet assemblies should on no account enter a brazing furnace, as moisture may damage the assembly at brazing temperatures, and the reaction between the aluminium and moisture may generate hydrogen and cause an explosion, or blistering of the aluminium. It is advisable to dry assemblies at about 200°C. for 20 min. before brazing.

For flux-dip brazing no prior flux coating is necessary.

Stopping-Off

Stop-off material is applied to assemblies, as with other metals, to prevent molten brazing alloy flowing beyond its prescribed area when the nature of the joint does not in itself ensure this. Several proprietary compounds of sodium fluoride and sodium silicate in water are available, which are applied as a paste and allowed to dry. They do not require baking before brazing and they are easily brushed off afterwards.

A different kind of stop-off paste is applied to jigs and racks to prevent their being brazed to assemblies. This usually consists of a mixture of equal parts of medium-heavy engine oil, fine graphite powder and petroleum ether or mineral spirit. It must be kept thoroughly stirred during application to prevent the separation of its constituents. The paste is applied by brush or by spray gun, and is baked into place at about 250°C. One application is usually effective over several brazing cycles.

Brazing

After the preparation, fluxing and stopping-off, the equipment and procedure for the flame brazing of aluminium is very similar to that of most other metals, there being no factor specific to aluminium for this process.

Furnace brazing is, however, a different matter. The furnace brazing of aluminium requires a temperature control to within 5°C. over a range from 540°C. to 650°C. As the transfer of heat depends partly on time, the actual furnace temperature used is less important than strict temperature control. Once the optimum temperature and time for an assembly have been set, they should be controlled automatically. The general conditions for brazing aluminium are a rapid rise in temperature, a short period at the brazing temperature, and a rapid cooling to below the solidus temperature of the alloy being brazed. Any heat-treatment furnace giving such conditions, and having its linings protected from attack by flux, is suitable.

Electrically-heated and gas-fired furnaces are both used. Aluminium-coated steel has been found to be the best material for furnace linings and equipment, although plain, uncoated steel is reasonably satisfactory if kept clean and free from scale by periodic cleaning. Furnace interiors should be free from dust.

A high rate of heat input ensures that the work is raised to the brazing temperature rapidly, and so prevents excessive alloying between the filler metal and the parent metal. For efficient operation and large production the furnace capacity should be large. An even distribution of heat throughout the chamber is a definite advantage, and this should preferably be attained by forced air circulation and baffles. Experience has shown that furnaces without forced air circulation are usually too slow for efficient production. No useful purpose is served by having an inert or reducing atmosphere in the furnace.

Dip-brazed aluminium heat exchanger *[Courtesy Marston Excelsior Ltd.*

Jigs complicate the process and increase the time for each operation; they should be used only when essential, and then should be light and of simple design. They should have minimum contact with the work so as not to impede uniform heating. The repeated heating and cooling of jigs tends to distort them and shorten their useful life.

Pure aluminium and aluminium alloys of the higher melting range are the most suitable materials for jigs, although mild steel and malleable iron are often used. Nickel-chromium is superior to stainless steel in resisting flux attack, but with both, limited life—resulting from distortion—necessitates simple construction to avoid expense.

Aluminium in thicknesses ranging from 0·006 in. to 0·5 in. can be furnace brazed at temperatures and brazing times appropriate to thickness and composition.

The cleaned components and brazing alloy—or the parts made from clad sheet—are assembled and fluxed, by brush, spray gun or dipping, and then dried. From the flux-drying oven the assemblies should pass directly into the brazing furnace, so that little heat is lost and no moisture from the air is absorbed by the flux.

As a general guide to timing, light gauge sheets take from 2 min. to 6 min. from the time that the brazing temperature is reached until filler metal has filled the joint, and from 4 min. to 15 min. for complete furnace treatment—but for this, heavier sections may take up to ½ hr.

Furnace temperature ranges are from 540°C. to 650°C., depending largely on the melting point of the material being brazed. Apart from that, assemblies of uniform section and heavy-gauge material, with joint areas equidistant from the heat source, usually require higher temperatures than assemblies with varying thicknesses of section and of light-gauge material.

When parts of the joint area are located a good deal away from the source of heat, assemblies require a lower furnace temperature in order that all parts may reach brazing temperature at the same time.

For a period immediately after brazing, the hot assemblies—especially of thin components—are easily bent or distorted. Thus, they must be removed from the furnace with care and allowed to cool naturally until the joints have

completely solidified and the surrounding metal has regained its strength.

Heat-treatable alloys must be reheated and quenched at the appropriate temperature to restore their full properties, although quenching from the brazing temperature results in partial restoration. Quenching also loosens and partly removes the residual flux, thereby simplifying the final cleaning process. Thin gauge material may become distorted if quenched by immersion, and water sprays may be used to minimize this by ensuring that all parts are cooled simultaneously.

Flux-dip brazing, a development from furnace brazing, is used largely in the quantity production of assemblies having a large area of jointing in relation to their size—for example, heat exchangers and radiators. The process is suitable for any aluminium alloy capable of being furnace brazed.

For general production, the most suitable bath is a refractory one in which the flux is heated by alternating current at low voltage passing between two immersed electrodes of carbon or chemically-resistant nickel alloy. Nickel alloy pots, heated electrically or by coal gas and compressed air, are also used, chiefly for batch or development work on a small scale.

The bath should be large enough to take the biggest assembly without undue turbulence or excessive chilling of the flux. The temperature should not drop more than 5°C. below the required flux bath temperature when the assembly is dipped.

For pot linings, high-alumina brick has been found suitable. High-silica brickwork is not satisfactory because silicon combines with the fluoride in the flux, causing rapid deterioration. For electric operation, a most satisfactory lining is one of coke bricks or carbon blocks with a backing of refractory brick. The bricks, or blocks, must be dried out completely and kept dry and hot during the building of the lining in order to prevent pick-up of moisture.

When the pot is in operation and filled with molten flux, the lining of bricks absorbs flux until it is saturated and does not absorb further moisture, except superficially. The lining surface must, however, be dried by reheating immediately before each refilling with flux. Bricks for repairing the lining must also be dried and fitted while hot.

Electrodes of Monel or nickel are preferably placed horizontally along opposite sides at the bottom of the pot. This produces more even heating, with less sludge than the alternative method of placing electrodes vertically down one side of the pot. The electrodes are insulated from the lining—which becomes conductive when saturated with flux—by a run of insulating bricks.

When cleaning and recharging with powdered flux, the fresh flux is added until it just covers the electrodes—or the lower ends of the vertical ones; it is then melted with a torch until a puddle is formed around and between the electrodes. Current is switched on, providing sufficient heat to finish melting the charge. Flux is added to the required depth, allowing for displacement by the work to be immersed.

The flux itself is then dehydrated by dipping into it a sheet or some other form of pure aluminium. The reaction evolves hydrogen, which ignites and produces small flames on the surface until dehydration is complete. For a fresh charge of flux, the complete removal of moisture by this means may take 48 hr., but for make-up charges only about 30 min.

Local overheating near the electrode may give rise to chemical changes in the flux and decrease its activity, causing the flux to "freeze" and solidify at that point. The addition of about 1½ lb. of lithium chloride for each 1,000 lb. of flux lowers the melting point by replacing the lithium chloride lost during operation or in the overheating. Loss of fluorine, which also weakens the flux, is made good by the addition of cryolite until the activity is normal. Dip pots which are kept at brazing temperature but used only intermittently suffer from the formation of sludge, which settles on the bottom of the pot, hardens, and becomes extremely difficult to remove if it is not dealt with frequently.

In a 1,000 lb. pot, about 5 lb. of sludge forms daily and should be removed at least every other day. The continuous use of the pot, with consequent replenishments of fresh flux, reduces the formation of sludge, but impurities will appear at intervals, as indicated by the darkening of the parent metal when brazed. These impurities may be removed, as before, by dipping pure aluminium into the bath.

It will be seen that for economic operation the flux bath must be continuously maintained at the brazing temperature. Production runs must be long, as a shutdown of plant involves an expensive procedure to bring it back into operation.

Components retained by fit alone form the ideal assembly, but otherwise riveting, welding and seaming are all used. If jigs are essential, they should be of pure aluminium, nickel, Nimonic 75 or Inconel. Other nickel alloys or stainless steel are less satisfactory because they deteriorate more rapidly by attack from the flux constituents, with consequent contamination of the flux.

Cold assemblies immersed in a flux bath become coated with solid flux, which is thermally insulating and is difficult to remove in a reasonable time by continued immersion. They are often moist, and on immersion may cause a dangerous explosion. They also reduce the temperature of the flux.

Assemblies should, therefore, be preheated to about 540°C. in a furnace, which should be located as near the dip pot as possible so as to reduce heat loss during transfer of the assembly. The control arrangements should enable the preheating temperature, once established, to be repeated for subsequent batches of similar work.

The assemblies are immersed in the flux bath just long enough for the filler metal to flow freely. Over-long immersion results in a flux attack on the base metal and also allows excessive diffusion to occur between the filler and the base alloy. Rapid and thorough draining is most important to reduce drag-out losses and the consequent time lost in dehydrating make-up charges of flux.

Flux should be kept away from places difficult to drain; for example, the open ends of tubular assemblies are often given temporary extra length so that they can be kept out of the flux while the remainder is immersed.

Great care is needed when operating flux-dip baths, especially by protecting operators against spatter. Forced ventilation may also be desirable to safeguard the operative against the toxic effect of fumes, as already mentioned.

After adequate draining, assemblies should be allowed to cool naturally until the joints have completely solidified and the surrounding metal has

(*Continued on page* 166)

TABLE II—CHEMICAL CLEANING

Stage	Method A			Method B		
	Solution	Temp.	Time (min.)	Solution	Temp.	Time (min.)
1	Concentrated nitric acid	Room	5–15	10 per cent nitric acid, 0·23 per cent hydrofluoric acid	Room	5–10
2	Water rinse	Room	—	Water rinse	Room	—
3	10 per cent nitric acid, 5-10 per cent sodium dichromate	Room	5–10			
4	Water rinse	Hot	—	Water rinse	Hot	—
5	Dry off, using warm air	—	—	Dry off, using warm air	—	—

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Transfer Mechanism for Power Presses

TRANSFER feeds for existing presses, which, in some cases, may be applied to existing tools, have been introduced by Press Equipment Limited. In its simplest form, the transfer comprises two pick-up heads, simultaneously gripping a blank component from a location outside the tool area and the processed component from the press tool, lifting to clear locations and die form, traversing, then lowering the blank into the die and the processed component on to an ejection chute.

For more than one tool an additional pick-up head is required for each station, so that the component is progressed through each tool until it reaches the ejection point.

The transfer is suitable for feeding by hand or magazine location, or blanks may be taken from coil material that is decoiled, straightened and fed direct to a blanking tool by the Bow Feed method developed by the company. This combination provides a completely automatic line.

On presses of speeds up to 24 strokes/min., of suitable stroke and tool daylight, the transfer is usually driven from the crankshaft, and the press runs with the clutch continuously engaged. On faster presses, and where tool daylight is restricted, the transfer is self-motorized and engages the press clutch at each cycle after the components have been transferred and located, and the carriage has returned to its mid-position.

Removal of the processed component is automatically checked at every stroke to ensure tool protection.

Rare Earth Metals

RARE earth elements, with their compounds, form a hitherto little-known but potentially valuable range of materials. Also known as "lanthanons," they comprise the fifteen elements from lanthanum (atomic number 57) to lutetium (71). Scandium (21) and yttrium (39), the first two members of the same sub-group in the Periodic Table, are similar chemically and in their atomic structure. Element 61, promethium, does not occur naturally, but one of its isotopes has been isolated from the products of nuclear fission.

For some years, active research on the rare earths has been carried out by Johnson, Matthey and Co. Ltd., and supplies of the rare earths in their normal form as oxides have been available in several grades of purity. Improved techniques for the production of the metallic elements have now been brought to fruition, and all of the fourteen naturally occurring elements, together with the closely related elements scandium and yttrium, are now available in a variety of forms.

The metals are reduced from their fluorides with lithium, calcium or lanthanum in tantalum crucibles in an atmosphere of argon, and are then remelted in vacuum. Impurities are held at a very low level, and in some cases the purity is higher than has hitherto been achieved.

Lanthanum, cerium, praseodymium and neodymium oxidize readily at room temperature and must be preserved in airtight containers, but all the other metals, except europium, acquire no more than a superficial tarnish on prolonged exposure to the air at room temperature. Europium is highly reactive and, therefore, difficult to preserve and handle as metal.

All of the sixteen metals have been remelted into ingots or rods. Lanthanum, cerium, neodymium, praseodymium, yttrium and gadolinium have been successfully extruded, and subsequently drawn to fine wire.

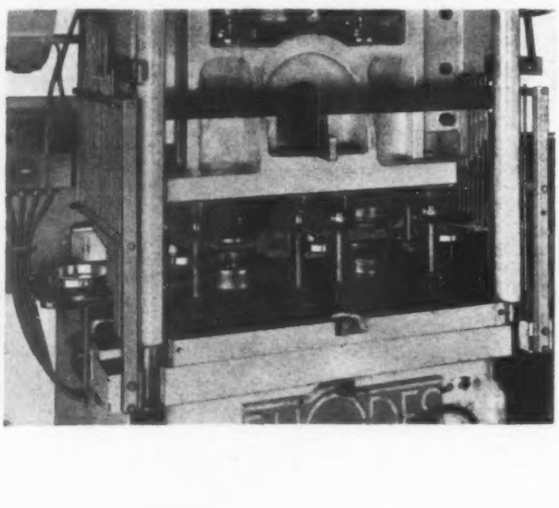
Soldering Fine Work

DEVELOPED from an N.R.D.C. patent by a small Scottish engineering company, a new thermostatic soldering iron with accurate temperature control is particularly useful for fine work, especially in the manufacture of delicate electronic components used in guided missiles.

The firm is the Cardross Engineering Co. Ltd. and their idea was to provide a temperature control of ±15°C. at a normal setting of 230-250°C. Enquiries at the Patents Library, however, showed that the General Post Office already had a patent in existence covering the idea, and as this was in the hands of the National Research Development Corporation for exploitation, a licence to manufacture was applied for.

The next step was the development of the basic idea, which was to make the differential expansion of an inner non-ferrous metal rod and an outer case operate a micro-switch by an intermediary magnifying lever movement. Trials showed that a number of points required further investigation and experiment. As a result, the expensive Invar steel (an iron-nickel alloy with a low coefficient of expansion) originally specified was dispensed with. In its place an ordinary mild steel was used, cutting costs by about 50 per cent.

Difficulty was experienced in obtaining a correctly



Left : A two-tool, three-head transfer set up to produce 720 components per hour with one operator. This previously entailed two presses and two operators to produce 400 components per hour

Below : The thermostatically-controlled soldering iron, developed by Cardross Engineering Co. Ltd., for fine work

wound heating element. This was overcome by winding it with a uniform light tension to avoid excessive tightness of the wire, which would cause breakage. Finally, the problem of heat transference to the handle was solved by cutting short the copper alloy expansion rod and joining it to a metal with low conductivity. This idea is now the subject of a patent application.

The Cardross Engineering Co. now manufactures two models of this thermostatic soldering iron—a 70 watt iron for production and repair work in radio electronics and other small work, and a 500 watt iron for general workshop use.

Vacuum Heat-Treatment

A VACUUM furnace in which the charge can be heated and quenched without exposure to the atmosphere has been developed by Vacuum Metallurgical Developments Limited for the heat-treatment of such metals as molybdenum, titanium and tungsten, stainless steels, and high-temperature alloys, including Nimonic.

The furnace is resistance-heated by a molybdenum winding, which can raise the temperature of the hot zone to a maximum of 1,500°C. Insulation is by means of radiation shields, and the furnace chamber is water-cooled. Below the furnace chamber is a trap door, leading, via a sealed hood, to the quenching tank. There is an atmosphere of inert gas (argon) in the hood at about atmospheric pressure.

The hot zone is 24 in. in diameter and 24 in. high, and the charge is hung in a basket from the lid. The air is then exhausted from the chamber with a 10 in. oil diffusion pump (whose capacity is 2,500 L/sec. at 10^{-4} mm. Hg), backed by a standard mechanical pump.

The temperature of the hot zone is then raised and controlled as required, and when the charge is ready for quenching, argon is admitted to the furnace chamber. When the pressure inside equals that in the sealed hood below, the bottom trap falls open, and the charge basket is automatically released and falls into the quenching tank. The release and quench operation takes about 5 sec.

The whole cycle takes from 20-60 min., according to the thermal capacity of the charge and the temperature to which it is raised.

Protecting Delicate Products

HIGHLY resilient moulds for the protection, during transport and storage, of delicate castings, assemblies or other products, are being made to individual order by Proteccopack Ltd. The low-priced packs save space and packing time, in addition to preventing damage and breakage.

The moulds have been submitted to the most stringent Ministry tests, and the manufacturers claim that filled Winchester bottles, packed in their moulds, can safely be dropped on to concrete from a height of 50 ft. without damage, and that fragile goods can withstand loads of 1,000 lb. stacked on top of them.

The moulds can be made returnable for the home market. While several journeys are normal, up to thirty journeys have been recorded on some packs. Fibreboard, softwood, or plywood outer cases may be used to give longer life to moulds which are to be used for several journeys in the United Kingdom, or for additional protection for overseas trade.

Translucent Ceramic Based on Aluminium Oxide

A POLYCRYSTALLINE ceramic that readily transmits light has been made from powdered aluminium oxide by the General Electric Company Research Laboratory, Schenectady, U.S.A. In addition to transmitting light, the new material possesses the extremely high strength characteristic of alumina ceramics, can withstand much higher temperatures than most ceramics now in use, and can be pressed into any shape desired.

The new material, called "Lucalox," is closely related to sapphire and ruby gem stones, which are single-crystal aluminium oxide. But this polycrystalline form of the same compound is superior to these gems in its ability to withstand high temperatures without deforming.

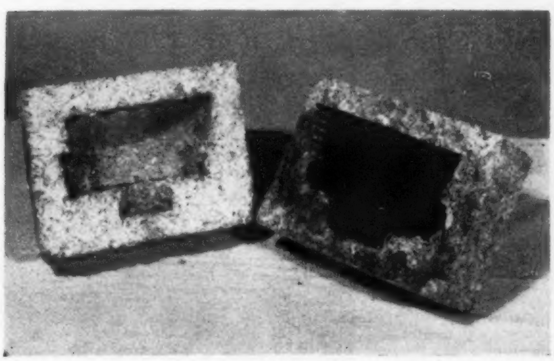
The light transmitting characteristics of Lucalox result from the fact that the microscopically small pores, or "bubbles", that are normally found in ceramic materials have been removed. It is claimed that at least ninety per cent of the light in the visible spectrum is transmitted through the new ceramic.

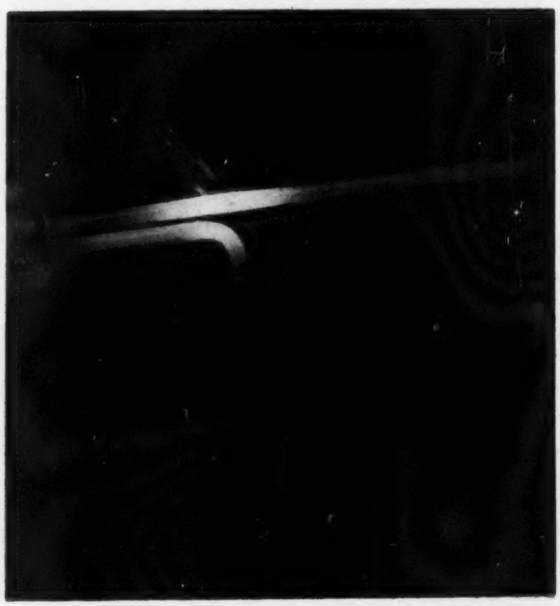
The basic material is fine-grain, high-purity aluminium oxide, or "alumina". The powder is pressed at room temperature, then fired at temperatures that are higher than usual for ceramics.

Applications for the material are being investigated, high intensity incandescent and discharge lamps being an obvious one. It may also be used as an electrical insulator and as a material for gem bearings in delicate equipment. The use of this ceramic should also extend the range of instruments and devices that are presently limited by the physical characteristics of available materials. For instance, whereas fused quartz performs satisfactorily up to 1,800°F., Lucalox is stable at temperatures close to 3,600°F.

Below: Air-cooled cylinder packed in Proteccopack mould

Right: Bar of "Lucalox" translucent ceramic and a bar of fused quartz heated together. At 2,350°F. the quartz bends under its own weight, the new ceramic supporting a 50 gm. weight up to 3,200°F.





Finishing Supplement

Plating Anodes

By D. J. FISHLOCK

EVEN after over a century of commercial electroplating, many platers fail to appreciate the paramount importance of the anodes in any electroplating process. Second only to faulty pretreatment, malfunctioning of the anodes is responsible for more plating troubles than any other factor. Basically, the anode's function is to provide a path for the current out of the solution (from the Greek *anodos*, meaning way up). Usually, too, it replenishes the solution's metal ions while it may promote certain salutary oxidation reactions at its surface. In order successfully to fulfil these functions, it must display certain characteristics, chief of which are:

(i) Free and uniform dissolution at an efficiency closely corresponding to, or just above, that of the cathode over a wide range of plating conditions, with no tendency to disintegrate, polarize or passivate.

(ii) High conductivity and, therefore, little loss of power through the anode circuit.

(iii) High purity and, thus, no tendency to contaminate the solution with soluble or insoluble impurities.

The conditions in (i) are achieved only by selection of the type of anode most appropriate to the process concerned, with particular regard to its method of manufacture and heat-treatment, but also to its size and shape. Heat-treatment can markedly influence solubility, a factor which has become increasingly appreciated in the past few years. Metal shortages and the need to minimize anode scrap, together with abortive attempts to use inferior grade materials, have focused attention on this point.

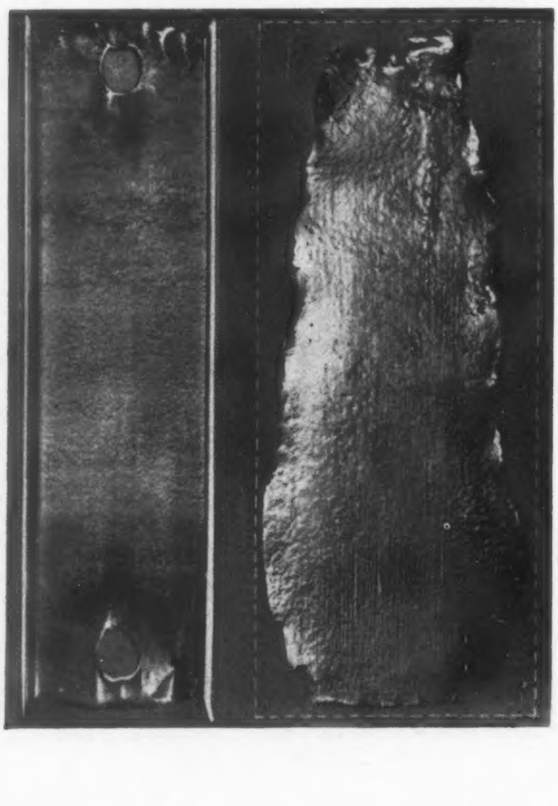
Cast anodes are usually formed in chill or permanent moulds, and tend to be coarse structured and freely corrodible.[1] The coarse structure does tend to allow intergranular attack and the partial disintegration of some anodes, but by yielding a relatively coarsely-divided sludge such anodes often present less trouble in bagging. The ball and elliptical anodes are also cast, and prove especially popular since there is virtually no scrap loss. These are used, in the case of cyanide solutions, in steel wire cages—preferably of clipped rather than welded construction to avoid anodic weld corrosion; the steel plays a further vital role here, dealt with later.

Rolled and extruded anodes are of much finer grain size, and often have improved corroding characteristics, especially in the more active solutions. They can be produced in considerable lengths, and extruded anodes are sometimes chopped into small sections for use in cages. Electrolytic anodes, although the highest for purity, have limitations in that their structure may not be uniform, and they sometimes tend to polarize easily. In all cases, very critical heat-treatment and annealing are essential to their successful functioning.

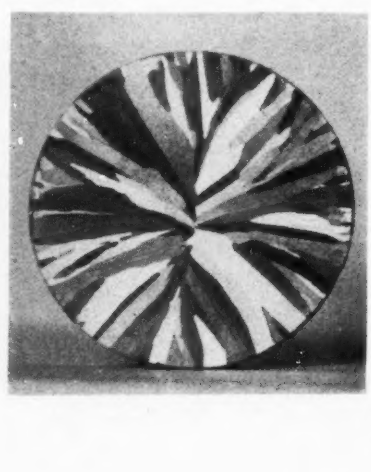
Anode shape has attracted much attention, since this can directly influence its surface area, and through this the uniformity of corrosion, the final scrap loss, the dispersal of gas from its surface and the tendency to polarize. Oval and circular section anodes, sometimes with ribs, grooves or a sand-blasted surface, are displacing many of the flat smooth plates and strips of the past, while those of "dog-bone" section (Fig. 1) have been found very economical with the softer metals, notably silver and lead. A heavily-ribbed cast silver anode gives good service in an inclined barrel, a plating unit in which the anode area is normally remarkably exiguous.

In so far as composition is concerned, the tendency to-day is towards extreme purity in most anodes, this requiring the greatest care in their production. Sometimes small additions such as carbon and silicon in depolarized nickel anodes are beneficial, while other small alloying additions may replenish an essential bath constituent. Phosphorus in certain copper anodes[2] and cobalt in some nickel anodes are respective examples. Usually, though, trace elements, both metallic and otherwise, tend to contaminate the solution or form anode slimes; very often their elimination improves the conductivity and the corrosion characteristics of the anode, e.g. O.F.H.C. copper anodes (Fig. 2) and 99·97 per cent silver anodes.

Anode conductivity can also be of significance, since not only does an



Left: Fig. 1—It is claimed that in tests where Baker dog-bone shaped silver anodes and flat sheet anodes were operated under similar conditions until only 15 per cent of their original weight remained, the loss of surface area was about three times as much for the flat sheets



Right: Fig. 2—Section through an American Metal Climax Inc. O.F.H.C. (oxygen-free high-conductivity) copper anode. Among its advantages are claimed a low scrap loss—often less than 10 per cent, reduced sludging and higher permissible current densities

TABLE I—TYPICAL ANALYSES OF PLATING ANODES, PER CENT IMPURITIES

	As	Bi	C	Cu	Fe	O	Pb	S	Si	Others
Cadmium	0·005	—	—	—	0·1000	—	—	—	traces	99·99 per cent Cd
Nickel										
cast C	—	—	0·21	trace	0·10	—	—	—	0·05	99·6 Ni; 0·04 Mg
rolled C	—	—	0·25	0·02	0·07	—	—	0·01	0·25	99·3 Ni
cast dep.	—	—	0·01	0·01	0·20	0·2	—	0·01	0·10	99·6 Ni
rolled dep.	—	—	0·01	0·05	0·08	0·25	—	0·005	0·02	99·5 Ni; 0·01 Al; 0·005 Mn
electrolytic	—	—	trace	0·03	0·04	—	—	trace	trace	99·95 Ni
Tin	0·014	0·002	—	0·004	0·007	—	0·015	0·003	—	0·007 Sb; 99·94 Sn
Zinc	—	—	—	0·01	0·01	—	0·08	—	—	99·81 Zn; 0·08 Cd
Copper (E.T.P.)	0·0006	0·0001	—	99·956	0·001	0·034	0·001	0·0015	—	0·0013 Ag; 0·0014 Ni
fire refined	0·005	0·002	—	99·781	0·005	0·070	0·010	0·003	—	0·006 Ag; 0·09 Ni
O.F.H.C.	0·0003	0·0001	—	99·994	0·0005	nil	0·0006	0·0012	—	0·001 Ag; 0·0006 Ni

SOME BRITISH STANDARD SPECIFICATIONS FOR ANODES

Anode	Specification	
Cadmium	B.S. 2869:1957	Not less than 99·95 per cent Cd; impurities must not exceed 0·05 per cent (Sb + As + Ti not more than 0·01 per cent)
Lead (chemical)	B.S. 334:1934	Not less than 99·9 per cent Pb, but if Cu is present the Pb content may be reduced by an amount not exceeding the amount of Cu: max. limits; Ag, 0·002 per cent; Bi, 0·005 per cent; Fe, 0·003 per cent; Sb, 0·002 per cent; Zn, 0·002 per cent; Cu, 0·05 per cent; Ni + Co, 0·001 per cent; Sn, Cd, As, traces.
Zinc	B.S. 2656:1956	Max. limits:—Pb, 0·003 per cent; Cd, 0·003 per cent; Hg, 0·004 per cent; Pb + Cd + Hg + Fe, 0·02 per cent
Nickel	B.S. 558:1934	Not less than 99 per cent Ni + Co; Ni, 98·5 per cent; max. limits:—Fe, 0·75 per cent; Cu, 0·25 per cent; Si, 0·1 per cent; Mn, 0·1 per cent; C, 0·3 per cent; Zn, 0·01 per cent

appreciable resistance mean a loss of power but it can influence the plate's distribution. This factor should be considered in determining the optimum length of an anode: it is normally a few inches shorter than the cathode, but for close conformity to a thickness specification must be determined empirically. With inert anodes the resistivity can sometimes be used to control closely, for example, the amount of current reaching the lower end of a tube being plated internally; this is by virtue of the volt-drop down the anode's length.

Anode hooks are a frequent cause of contact trouble. These are advisedly of square section, so that they give a line rather than a point contact; the high pressure on the sharp contact edge of the hook will pierce any films on the anode bar. More elaborate hooks are sometimes provided with spring or screw devices to improve the contact pressure. Hooks require to be very firmly affixed to the anode and, preferably, the join should be sealed with a rubber or plastics cap, or lead seal if permissible, to prevent the ingress of plating solution.

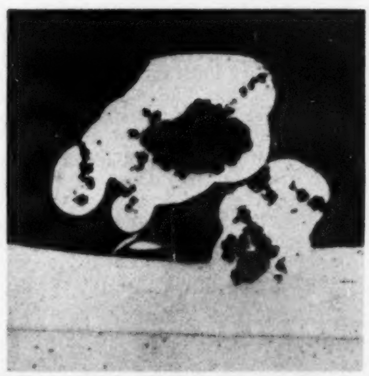
Alloy Anodes

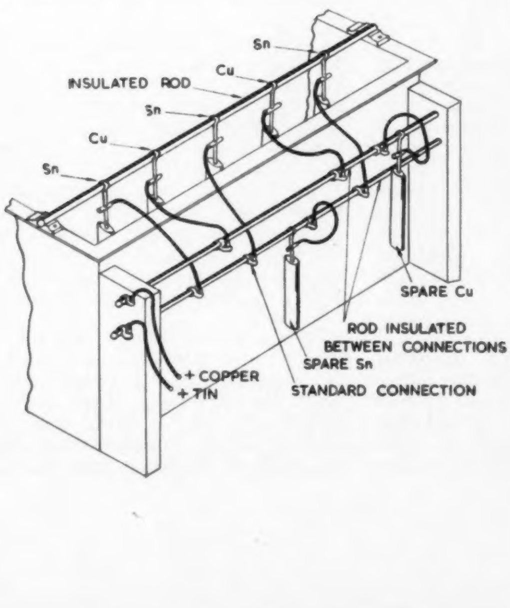
It is imperative that, in any development work on alloy plating, the earliest consideration be given to the anodes; many a promising alloy process has failed completely in production owing to the difficulty of persuading the anodes to replenish the solution at the same rate as it is depleted of metal ions. There are four anode systems

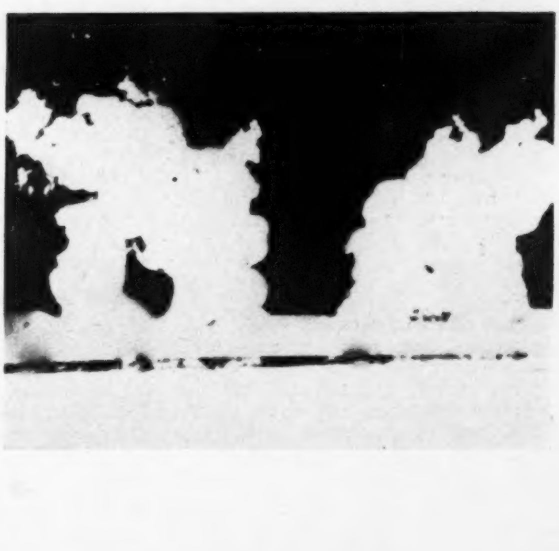
Below left: Fig. 3—This method of connecting the anodes in speculum plating is recommended by the Tin Research Institute for small vats. It saves space, avoids hanging anodes on the wrong bar, and permits closer positioning of anodes

Right: Fig. 4—Vertical section through a hollow nodule in a bright nickel deposit. Material responsible is believed to have been tiny nickel particles dislodged from the anode [Courtesy B.N.F.M.R.A.

Below right: Fig. 5—Vertical section through a deposit formed in a bright nickel solution in which colloidal graphite was suspended [Courtesy B.N.F.M.R.A







for alloy plating currently in use,[3] viz. soluble alloy anodes, soluble but individual constituent anodes, inert anodes, and combinations of the first two and/or the third system.

Most convenient, of course, are the alloy anodes—although the anode constituents are not necessarily present in the same ratio as the final deposit. In brass plating, anodes of the same ratio can be used, and are available with from 20 to 35 per cent of zinc. In tin-nickel plating, however, anodes containing 35 per cent nickel, as in the deposit, consist of two intermetallic compounds, Ni_3Sn_2 and Ni_3Sn_4, of which the former dissolves preferentially; anodes of 72-73 per cent tin, i.e. entirely of Ni_3Sn_4, or else separate anodes, are, therefore, used.[4]

Alloy anodes are preferably in a single phase solid solution, since twin phases usually have different rates of dissolution at a given potential.[3] However, both mechanical mixtures and intermetallic compounds find application. There is sometimes difficulty in obtaining anodes of the required composition by normal metallurgical techniques, but this can always be overcome by producing them electrolytically if the expense is justified.

Failing the availability of a suitable alloy, however, separate anodes are needed. With careful attention to the solution and operating conditions, these can often be operated from a single anode rod or, if the difference in anode potential is slight (e.g. 0·1 V in tin-nickel solution), a small fixed resistor can be incorporated in the hook of (in this case) the tin anode. Separate or dual anode circuits are advisable if the difference in potential is appreciable. The rate of metal dissolving from each set of anodes can then be closely adjusted by means of the current density on each, the potential difference between the two sets, and between each set and the cathode. Each anode bar should be supplied and metered independently; a very compact dual anode bar is shown in Fig. 3. This arrangement also permits closer positioning of the anodes and prevents anodes being placed on the wrong bar. Separate anodes may also need independent attention in other respects: for instance, in tin alloy plating the tin anodes must be removed when not in use to prevent the formation of stannite, but in tin-nickel plating, when separate anodes are used, the nickel anodes should remain in the solution to help prevent oxidation of two-valent to four-valent tin.

Particularly if the proportion of one constituent in the deposit is small, it can be replenished by chemical additions. Salts are more costly than anodes, but this may be offset by the convenience, as in some cobalt bright nickel and molybdenum bright zinc processes. Inert anodes have also been occasionally used when soluble anodes prove entirely impracticable, but the control difficulties can rarely justify their use in continuous production.

The system has been used for depositing ternary alloys such as tin-copper-zinc and tin-copper-cobalt.

Copper Anodes

The raw material for all quality copper anodes is electrolytically-refined copper of 99·98 per cent purity or better. This material may be used unmodified as anodes but requires bagging, while brittleness of the deposit and anode loss due to partial disintegration are not uncommon occurrences.

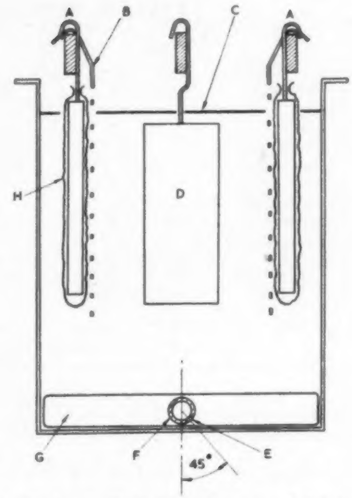
Cast anodes are produced by melting and pouring electrolytic copper, a procedure which is highly critical if the introduction of cuprous oxide is to be avoided;[5] this constituent causes disintegration of the anode. It can be avoided by deoxidizing the melt with phosphorus, which produces an anode containing about 0·02 to 0·03 per cent phosphorus and negligible amounts of oxygen.[6] Such anodes need no bags and corrode extremely uniformly. Another type of extreme purity anode is the oxygen-free high conductivity or O.F.H.C. anode (Fig. 2), which is produced by a patented sequence including melting in a reducing atmosphere in an electric induction furnace. This anode is above 99·99 per cent pure and provides cast anodes for use in both acid and cyanide baths without bags; corrosion is extremely uniform and the scrap loss negligible. Cast copper anodes perform most satisfactorily in acid electrolytes, while the deoxidized cast types are particularly valuable for heavy deposition and in electro-forming.

Rolled and extruded electrolytic anodes are preferred for cyanide electrolytes these having a denser, finer structure. They are available in very large sizes.

There is no reasonable limit to the current density for copper anodes in acid baths, but it is customary to use an anode area roughly equal to that of the cathode; in cyanide solutions, however, the anode area should be about double that of the cathode, while a limit of 20 to 30 amp/ft^2 must be observed. Excessive anode current densities in cyanide solutions result in anode polarization due to the formation of a green slime which rapidly re-forms when removed unless the plating conditions are modified. Inert anodes of steel are also often used to lower the anode efficiency in cyanide solutions. Iron does tend to dissolve and form ferrocyanide, but it remains a debatable point whether, in small amounts, this has any adverse influence on the plating. Similarly, hard lead anodes may be used in acid electrolytes.

Nickel Anodes

The cathode efficiency in nickel plating is high—about 95 per cent—and for satisfactory operation that at the anode must approach 100 per cent. Pure nickel, however, tends to passivate quickly, even when the electrolyte



A—Anode. B—Plastisol-coated screen. C—Solution level. D—Cathode. E—Air holes. F—Plastics agitation pipe. G—Combined weight and locating piece (rubber or plastisol-covered mild steel). H—Cloth anode bag.

Fig. 6—Simple method of protecting anode bags in air-agitated solutions, devised by Electrochemical Engineering Co. Ltd.

contains much chloride and controlled additions of certain non-metals (carbon, silicon and oxygen) are essential if anodes are to function at commercially-feasible current densities. The anode must none the less be extremely pure otherwise, since nickel solutions are very susceptible to metallic contamination, while the distribution of the additions and the structure of the anodes are highly critical.[7] The writer recalls an experience in heavy nickel plating in which it was found that a handful of the many oval rolled depolarized anodes in use corroded irregularly, developing long undercut furrows down their length, and slimy black deposits; they degenerated into lumps of spongy nickel long before their life should have ended. There was no difference analytically, and apparently no difference structurally, between good and bad anodes, but the clear disparity in performance was attributed to some irregularity in the annealing.

Depolarized anodes are invariably rolled, and contain about 0·25 per cent of oxygen as nickel oxide. This oxide must be distributed uniformly throughout the anode at grain boundaries, and results in an anode capable of operating over a wide pH range in all types of solution, and corroding extremely uniformly with little scrap. Its corrosion is impaired, though, at low current densities, and not more than one anode per foot of anode bar is recommended, while a good contact must be maintained.[8]

Carbon anodes, both cast and rolled, are for use in solutions below pH 4·5, and especially in the latest organic bright nickel baths. They contain carbon and silica, which form an adherent surface film to retain crystals and flakes of nickel as they become

detached until they dissolve. They are believed capable of retaining some 0·04 per cent of their weight in this manner. All nickel anodes are nearly always bagged, in view of the economic importance of avoiding rough nickel plates, but one large plant has reported using unbagged carbon anodes.[9]

Electrolytic anodes are particularly pure, and work well in low *p*H, high chloride solutions if correctly rolled and annealed.[10] The latter imparts a relatively coarse crystal size which assists bagging. They can also be used in cobalt-alloy solutions where a lower anode efficiency can be advantageous in some instances and, when broken into small pieces, in anode cages.

Anode Slimes

The anodes are prone to introduce a large proportion of the insoluble impurities suspended in a plating solution (Figs. 4 and 5). With the greatly increasing use of bright plating solutions and an appreciation of the greater porosity of deposits from cloudy solutions, solution clarity is assuming considerable importance, while it proves much more satisfactory to eliminate the suspended matter at its source than to try to filter it out. In addition, heavy incrustations of slime soon polarize some anodes and reduce their conductivity.

Anode slimes result either from an unsatisfactory crystal structure, leading to excessive attack at the grain boundaries and the dislodgement of crystals of metal, or from the impurity content of the anode. Unsatisfactory crystal structure, provided it is not due to incorrect heat-treatment, can be overcome by selection of anodes which have been worked and heat-treated in a manner most appropriate to the solution, current density and temperature at which they are required to operate. Solutions of high dissolving power, such as most strongly acidic and cyanide solutions, are, generally speaking, most advisedly worked with the somewhat less soluble rolled or extruded anodes, while less active baths may usefully employ the more soluble cast anodes.

It is virtually impossible, however, to eliminate anode slimes — chiefly because of the non-metallic additions and inclusions needed to ensure uniform dissolution, e.g. NiO in depolarized nickel anodes. The usually-adopted expedient is, therefore, to filter them out at the anode surface by bagging the anode. Ostensibly simple, this often proves far from easy, but is successful in a few instances, in particular in near-neutral solutions.

Nickel is the outstanding example, and nickel anodes have been successfully bagged for many years.

Many fabrics have been used for bags, but only a handful have proved their value; these include calico, cotton drill, flannel, muslin (with paper interleaved), Terylene, nylon, woven glass, Blue African asbestos, and a number of other synthetic fibres. Monofilament woven nylon is an especially versatile material; its tensile strength is double that of cotton fabrics, while its non-absorptive feature prevents solution from syphoning above the solution level and causing salt incrustations. It is resistant to alkalis, most solvents except metacresols and similar compounds, and to most inorganic solutions except strong mineral and oxidizing acids. The synthetics and glass, although often remarkably inert, do suffer from the poorer retaining power of their single-filament fibres, but there exist hirsute short-staple P.V.C. and nylon fibres of superior attributes. The cost of the newer fibres also tends to be materially higher.

The bags may be in double thicknesses for the more exacting applications—although there is a definite limit to this and to the tightness of the weave if the bag itself is not to polarize the anode by unduly retarding the migration of metal ions. It should be an inch or two longer than the anode to allow slime to accumulate, preferably non-shrinking, e.g. Sanforised, and is normally tied for support to the anode hook. The mechanical wear-and-tear, especially in air-agitated solutions, is quite heavy, and additional reinforcement at the bottom, and also at solution level where crystallized salts can accelerate deterioration, is often advisable. This can be supplied by extra thicknesses of fabric, or by impregnating these regions with a resin or lacquer. The reinforcement has the additional advantage of retarding the corrosion of the anode at the points where it is normally excessive, thus aiding uniform dissolution. German practice favours large bags about 6 ft. long to contain a number of nickel anodes, while it has been found that anode passivity risks are lessened by retaining the bag well away from the anodes; plastics cages may be used to achieve this. Another approach to the bagging of anodes is, of course, the auto-filter principle applied to certain nickel anodes with a carbon-silica content.

A simple but effective device has recently been developed to protect anode bags from ripping on sharp edges of the anode in vigorously air-agitated baths. This consists of a plastisol- or rubber-coated expanded metal screen hung from the anode bars[11] (Fig. 6).

Conscientiously maintained, an anode bag should last several times the life of the anode. Prior to being commissioned, however, it should be thoroughly rinsed in hot water or, better, in a solution of the same *p*H as the electrolyte; woven glass bags normally need degreasing to remove the spinning lubricant. It must be inspected frequently for holes, and it is strongly recommended that the bag is removed weekly and washed. The latter is most efficiently achieved by turning it inside out and using a hose. At the same time, the anode should be scrubbed. This frequent inspection is advised because it is easy to neglect bagged anodes until they have become excessively dirty or small.

Many of the troublesome features of anode bags can be eliminated by using some sort of diaphragm—in effect a glorified single anode bag. Developed particularly in connection with P.R. plating, these have much to commend them and deserve wider application; certainly they obviate the inhibited anode corrosion experienced when the anodes in cyanide solutions are bagged.

The principle is to separate the vat into two compartments with a fabric membrane, and use the pump to transfer enriched solution from the anode compartment, via a filter to the cathode section. Properly maintained, there is virtually no possibility of anode slimes finding their way into the catholyte.[12]

The most satisfactory system is to design the vat to incorporate a diaphragm.[13] Such a vat usually can have only one cathode bar, and needs to be somewhat larger than usual to lessen the risk of work brushing against and ripping the diaphragm. This increased anode-cathode spacing does improve throwing power and metal distribution, though. A rigid metal frame, usually of rubber-covered steel, is built up within the tank, positioned far enough from the tank walls to allow for the convenient handling of the anodes. This can take the form of a removable tubular structure over which a complete diaphragm is stretched, or a fixture into which a number of insulated expanded metal frames fit tightly; the latter allows for more convenient maintenance. The diaphragm is least expensively made of heavy canvas duck, e.g. a double layer of 11 oz. material. This has been found to have a life of six or nine months, but the more expensive synthetic fabrics may be preferred for longer lives; alternatively, the canvas can be resin coated at solution level where deterioration is most rapid, while several thicknesses of material may sometimes be considered justified.

The weave must be sufficiently fine to prevent the electrophoretic migration of anode particles, but, by arranging an adequate pumping pressure, a slight hydrostatic head of solution can be achieved in the cathode compartment: this will restrain the passage of particles without the necessity for unduly fine weaves and heavy volt-drops. Another method useful in keeping the surface of the catholyte free from floating particles is to fix the diaphragm's height so that there is a slight flow of solution over it into the anolyte. Separate filtration of the catholyte may prove desirable and can be achieved by having suction pipes, controlled by valves, in each compartment.

Another diaphragm system consists of using large insulated expanded metal baskets, covered with a suitable fabric, in each of which is hung several anodes. Each basket is provided with

a suction intake to the filter pump and compressed air agitation to prevent anode polarization.

The use of a porous ceramic diaphragm has been proposed but, while superficially attractive, its high cost and inherent fragility would militate against any widespread acceptance.

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(To be concluded)

Powder Metallurgy

CONTAINING the discussions and the Papers presented at the Inaugural Meeting of the Powder Metallurgy Joint Group of the Iron and Steel Institute and the Institute of Metals, which was held in December 1957, together with those at the two subsequent meetings held during 1958, Nos. 1 and 2 of "Powder Metallurgy" were issued in 1958, whilst No. 3 is the first of the 1959 issues. In the "Objects" of the Group it is stated that the intention is to hold two meetings each year, the Spring meeting "devoted to an informal discussion or a Symposium on a subject related to industrial aspects of powder metallurgy" and the Autumn Meeting "to discuss specially invited Papers describing original research in some field of powder metallurgy".

In keeping with this policy, the three meetings covered in Nos. 1 and 2 comprise the Inaugural Lecture by Dr. Ivor Jenkins on "Recent Developments in Powder Metallurgy", which was followed by a Symposium on "Developments in the Production and Quality of Metal Powders"; the informal discussion on "Developments in the Practice of Compacting and Sintering" at the second meeting; and finally the Symposium at the December meeting, on "The Powder Metallurgy of Metal-Ceramic Materials".

There are six Papers in the section on Metal Powders, covering the processes of atomization, electrolytic methods, production of reactive metal powders, mechanical methods employed in carbide production, and a most informative Paper on powders produced by the gaseous reduction of aqueous solutions. A very comprehensive discussion concludes the section.

Seven Papers are included under "Compacting and Sintering", dealing with the use of moulds made from reversible gels; the rolling of strip; hot working within sheaths; pressureless sintering; and zone sintering, and two Papers are included on the vacuum sintering field.

In the Symposium on Metal-Ceramics, the six Papers begin with a most competent review of the "Silicides and Borides of the High M.P. Transition Metals", by Kieffer and Benesovsky, followed by a Paper on "Bonding in Carbides, Silicides and Borides"; a "Study of High Temperature Properties of Ceramics and Cermets"; and two Papers on the fabrication and properties of various cermets.

Issue No. 3 contains five original research Papers, three of which are concerned with powder rolling.

The contributions to the informal discussion on "Theoretical Aspects of Sintering" are, indeed, international, and speak well for the wide attention this Joint Group has already attracted abroad, the Papers having been contributed by Rene G. Bernard, of Université de Lyons, on "Processes in Sintering"; by Geach, of A.E.I., on "British Developments in Sintering Theory"; J. T. Norton, of M.I.T., contributes "Current Progress in Sintering Theories in U.S.A.", which is followed by "Recent Work on the Theory of Sintering in the German Democratic Republic," by F. Thummler, and finally, a Paper on "The Mechanism of Sintering in Single Component Systems", from the Academy of Sciences, Kiev.

The issue concludes with two short contributions, one on "The Oxidation of Hot Pressed Ti Carbide and Boride", and another on "Interstitial Structures" by Kiessling, of A.B. Atomenergi, Stockholm.

The 20 Papers in Nos. 1 and 2, and 12 in No. 3, cover a very wide field in powder metallurgy, a great deal of it with very practical aspects and applications, and it is evident that subscription to the publication will become essential to all engaged in research and development in this field.

The printing and diagrams are in the familiar style and usual high standard of the two Institutes concerned.

For members of either of the Institutes the cost is the outstandingly low one of 10s. per annum, while for nonmembers it is 25s. per annum.

Brazing Aluminium

(*continued from page 159*)

regained its strength. Heat-treatable alloys should be quenched at the appropriate temperature to restore their full properties.

The quick removal of flux after brazing is essential, and it must be regarded as part of the brazing process. Immediately the assembly can be handled, the fluxed areas should be washed in hot water or steam cleaned, and, where practicable, the residue brushed off with a stiff bristle or wire brush. Chemical cleaning may also be used in addition to water cleaning—especially if the flux is difficult to remove, for example, from crevices. Several solutions are available, and two methods are given in Table II, of which Method A is the more common.

Method B gives a good uniform appearance to joint surfaces, as it counteracts the darkish appearance in the joint caused by the silicon content of the filler metal. Thorough rinsing after acid cleaning is essential. The first rinse—cold—is run to waste. The second rinse—hot—is to shorten the drying period. If the dried assembly bears water stains it may be necessary to rinse with hot distilled water, steam condensate, or with de-ionized water instead of mains water.

A simple test for the presence of flux after cleaning is to apply to the joint area a 2 per cent solution of silver nitrate to which has been added a small quantity of nitric acid. As some tap waters give a response to silver nitrate, the testing solution should preferably be made with distilled water. If a white precipitate appears, the cleaning operation should be repeated.

The good appearance of a sound, brazed joint can be further improved by grinding or buffing as necessary. Brazed assemblies can be anodized and acquire additional corrosion resistance thereby, or they can be painted.

As a general rule, any distortion associated with the brazing of aluminium can be allowed for at the design stage. Otherwise, most forms of distortion are corrected by mechanical means without unduly affecting the strength of the brazed joints, as assemblies after brazing are in the annealed condition. A completely closed hollow assembly provides a special case, for it may collapse when the internal pressure is reduced on cooling or quenching. A small vent hole, which can be closed later by flame brazing, may be used to avoid this occurring.

Industrial News

Home and Overseas

Modern Heat Treatments

Practical demonstrations of high temperature equipment are being organized by the **Morgan Crucible Company Ltd.**, in co-operation with the Merseyside and North Wales Electricity Board and the North Western Electricity Board. The first of these demonstrations will be held at the Industrial Development Centre, Paradise Street, Liverpool, from October 12 to 20 inclusive, and the other at the Main Electricity Board Showrooms, Town Hall Extension, Manchester, from October 26 to 30 inclusive.

A number of high temperature furnaces illustrating the versatility of "Crusilite" furnace heating elements will be operating at temperature throughout the exhibitions. The complete range of elements now available, associated refractory materials, as well as experimental mock-up furnaces, will also be displayed.

Tungsten Ores

It is announced by the Board of Trade that they have instructed their agents, British Tungsten Ltd., to resume sales of a limited quantity of tungsten ores as market conditions permit. Sales will be made gradually in the U.K. and abroad so as to avoid disturbance of the market.

Factory Extension

A new extension to the factory of **Electropol Processing Ltd.**, at the Farnham Trading Estate, Surrey, will treble its present capacity. This is the fourth extension since 1952, when the company moved from the Nissen hut opposite the Bourne Mill at Farnham. This new extension of 13,000 ft^2 will considerably increase the facilities for the Electropol processing of metals.

The Electropol method is said to leave a permanently bright polished surface which is self-repellent of dirt and moisture. This process was developed and patented with additional world patents by Electropol Ltd., and Electropol Processing has the sole jobbing rights of the processes for the United Kingdom, while the company is also interested in the establishment of the processes overseas, either on direct production or a licensing arrangement.

Sulphuric Acid Manufacture

Described as the first of its kind in this country, a plant producing SO_2 gas for sulphuric acid manufacture, using by-product ferrous sulphate, has recently been put into commission by **Chemical Construction (G.B.) Limited** and Dorr Oliver Limited at the Grimsby works of British Titan Products Co. Ltd.

This plant decomposes dried ferrous sulphate with coal in fluidized bed roasters. It was designed and built by Chemico using Dorr Oliver Fluo solid reactors. The product, SO_2 gas, is converted to SO_3 for sulphuric acid production in one of the existing converters on the plants supplied by Chemico. Our illustration on this page shows the plant installed.

Induction Heating

A course for users and potential users on induction heating is being organized by the **R.F. Heating Division of Pye Limited**. This course will commence at 2 p.m. on Tuesday, December 1 next, and finish at 6 p.m. the next day. It will cover the theory of induction heating, how the generator works, the design of coils for hardening, annealing, tempering, brazing, soft soldering, and special applications.

The course itself is free, but members attending have to pay their own living accommodation, which the company normally arrange. Further details of the course may be obtained from Mrs. E. Raeburn, Pye Process Heating, 28 James Street, Cambridge.

An Anniversary

Manufacturers of industrial control instruments, **Foxboro - Yoxall Limited** have this year reached their 25th anniversary. A number of special events were planned to mark this occasion and two of these, an Open Day and a Sports Day, were held with great success last month.

On the Open Day, over 1,000 staff and their families were invited to tour the Redhill factory, where each department had mounted an explanatory display of their particular products, and a central exhibition demonstrated the ranges of the company's finished instruments and systems of process control. On the following day, the company were hosts to their staff and families on their playing fields, where various sporting events were held, including team competitions, etc.

Export Credits

It has been announced by the Board of Trade that the Export Credits Department is now prepared in appropriate cases to insure capital goods business with Yugoslavia on terms of credit extending to five years from date of shipment. Hitherto for this market the limit has been three years from shipment.

The Department's liability under this new cover for capital goods business with Yugoslavia will be 75 per cent of loss for all risks covered. This relaxation is intended to enable U.K. manufacturers of capital equipment to continue to compete for business in Yugoslavia now that the recent (February 1959) U.K. Government loan is fully committed.

Israel Copper

A spokesman for the Israel Ministry of Development in Tel Aviv has announced that the copper plant at Timma has started full production. The plant is stated to be now processing 1,500 tons of copper, and producing daily 25 tons of copper cement with a copper content of 75 per cent.

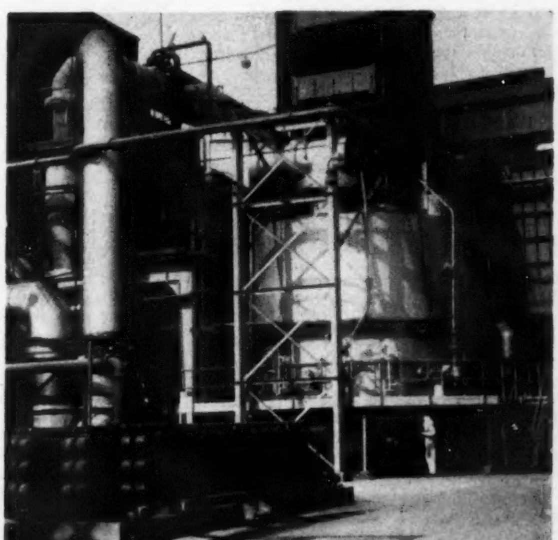
A New Factory

New factory premises at Port Causeway, Bromborough, erected since the war, have been taken over, it is reported, by the Birmingham firm of **Serck Radiators Ltd.** This new factory will be occupied by the Serck associated company—Audley Engineering Company Ltd., who manufacture valves.

Golfing Society

On Wednesday of last week the **National Association of Non-Ferrous Metal Merchants' Golfing Society** held its Autumn Meeting at the Edgbaston Golf Club, Birmingham. In the morning, a Medal round was played for the Captain's Cup and the Ellis-Masur Veteran Cup. The winner of the Captain's Cup was Mr. J. Wolff (Rudolph Wolff and Co.), the runner-up was Mr. D. Stirratt (R. M. Easdale and Co. Ltd.), and third was Mr. R. M. Easdale (R. M. Easdale and Co. Ltd.). The winner of the Veterans' Cup was Mr. S. C. Suckling (Suckling and Thomas Ltd.).

In the afternoon, a Greensome against Bogey was played for the Autumn Greensome Cup, the winners being Mr. R. M. Easdale and Mr. D. Stirratt, with Mr. J.



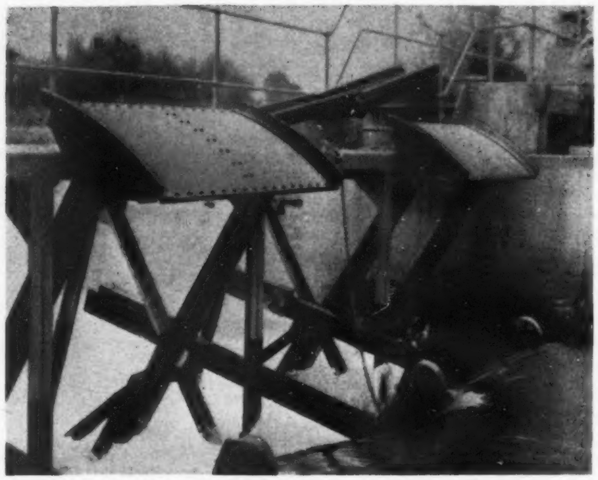
Ferrous sulphate decomposition plant installed at the Grimsby works of British Titan Products Ltd., by Chemical Construction (G.B.) Ltd.

Wolff and Mr. G. Tranter (G. E. Tranter Ltd.) as runners-up.

Light Alloy Sluice Gates

A little over eight years ago we were notified of the installation of 31 Birmabright light alloy sluice gates, which had been installed on four Thames weirs. At that time the comment generally was that if all these gates proved to be as durable as steel gates, the use of Birmabright alloys should be even more advantageous for larger, geared radial gates and for automatic tipping gates.

It is now reported by **Birmabright Limited** that a recent inspection by their engineers showed no deterioration whatsoever. The gates were fabricated from Birmabright standard extruded sections and have Birmabright skin plates and rivets. They are stated to be only half the weight of similar steel gates, and are counterbalanced for easy hand operation.



Light alloy sluice gates installed by Birmabright Ltd.

Branch Warehouse

It is learned from the management of the Smiths of Clerkenwell group of companies that a new branch warehouse has been opened at 115 Hitchin Street, Biggleswade, Beds. Trading under the name of **J. Smith and Sons (Biggleswade) Ltd.,** this branch will carry a large and varied stock of non-ferrous metals for supply to customers in the surrounding areas.

Immediate free delivery of materials can be effected by the opening of this new branch, with its fleet of transport, in response to telephone or written orders. The branch is under the managership of Mr. L. A. Harrow, whose telephone number is Biggleswade 2071.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses at the end of last week rose 34 to 8,594 tons, comprising London 4,779, Liverpool 3,655, and Hull 160 tons.

Copper stocks rose 425 to 13,238 tons, and were distributed as follows:—London 3,222, Liverpool 6,641, Birmingham 375, and Manchester 3,000 tons.

A Removal

It is understood that as from Monday next (October 5), the administrative and technical departments of **Film Cooling Towers (1925) Ltd.,** will be moving to new and more commodious premises at Chancery House, Parkshot, Richmond, Surrey.

This move is necessitated owing to the increasing demand for the company's water cooling towers, designed on their special film flow principles. Telephone number of the new premises is Richmond 6494-8.

Canadian Metal Production

Production of nickel, copper, lead and silver was larger in July than in the corresponding month last year, while the output of zinc was smaller, according to the Dominion Bureau of Statistics. July totals were: nickel, 16,199 tons (12,796 in July 1958); copper, 36,296 tons (30,881); lead, 15,111 tons (14,276); zinc, 34,130 tons (35,239); and silver, 2,867,503 fine ounces (2,390,687).

A Social Event

Early notice is given of the half-yearly dinner of the **National Federation of Scrap Iron, Steel and Metal Merchants,** which is to be held on Wednesday, October 21, at the Mayfair Hotel, London, W.1.

Trade with Russia

Described as the first of its kind in this country, a full-time course for men and women concerned with trade with the Soviet Union will commence at the Balham and Tooting College of Commerce, London, on Monday next, October 5.

This course will last for nine weeks, and half of that time will be devoted to a practical study of Russian. No prior knowledge of the language will be assumed and members of the course should learn enough to ask simple questions, to read headlines and notices and to make themselves informed in general on everyday matters.

Equipment for Copper Mine

An order has recently been received from the Denver Equipment Co. for three classifiers, valued at £19,163 to be installed at a copper mine in Haiti. This equipment will be supplied by **Head Wrightson Stockton Forge Ltd.,** a subsidiary of Head Wrightson & Co. Ltd., to handle 500 short tons per day of copper ore.

This installation is part of a new development project at the mine to increase production, and the classifiers will be of the 66 in. simplex double pitch submerged type with a tank length of over 35 ft. and a spiral speed of 3¼ r.p.m. The classifiers will overflow all minus 100 mesh copper ore, and this particular type of grading equipment has been supplied by Head Wrightson to many metal mines throughout the world.

Meeting of Scientific Societies

The Third Annual Meeting of **Scientific Societies in South Wales and Monmouthshire,** will be addressed this year by Sir Harry Melville, F.R.S., whose subject will be "Research and Development in the D.S.I.R. Stations." Sir Harry Melville is Secretary of the Department of Scientific and Industrial Research and was formerly Professor of Chemistry at Aberdeen University and Mason Professor of Chemistry at the University of Birmingham.

The meeting is again being held in the Reardon-Smith Lecture Theatre, National Museum of Wales, Cardiff, and will commence at 6-45 p.m. on Friday, November 13. Admission will be by ticket only. Tickets are obtainable from the Secretaries of the local Sections of the respective Scientific Societies or from the Secretary, Co-ordinating Committee, Dr. R. Rawlings, University College, Newport Road, Cardiff.

The Scientific Societies represented at the meeting will be Royal Institute of Chemistry, Institution of Chemical Engineers, Institute of Fuel, Institute of Metals, Institute of Petroleum, Institute of Physics, Institution of the Rubber Industry, Chemical Society, Plastics Institute, Textile Institute, Society of Analytical Chemists, Society of Chemical Industry, Society of Instrument Technology, Mathematical Society, Newport and District Metallurgical Society.

A Useful Booklet

A comprehensive booklet covering all the company's main copper and brass sheet and strip production has just been issued by the Metals Division of **Imperial Chemical Industries Limited.** Covering some fifty-two pages, the booklet is divided into sections with the following headings:—

Sheet and strip, product quality, technical data and production range, copper, the brasses, copper-nickel alloys, bronzes and special alloys, while the final pages are devoted to various weight tables. Statistical data, diagrams, and many excellent illustrations are included.

Newfoundland Development

Negotiations with Labrador mining interests were expected to result in a subsidiary company's power development scheme on Hamilton River at Twin Falls, it was stated at the British Newfoundland Corporation annual meeting. Making the announcement, the chairman of the board, Mr. B. C. Gardner, said from 50,000 to 300,000 horsepower could be developed at that location. The initial size of the project would depend on demand when construction began. He said one customer—Wabush Iron Company—had confirmed their intention to take power.

The chairman said the corporation's subsidiary, British Newfoundland Exploration, and its associates had found several new mineralized areas under

favourable geological conditions. These included occurrences of asbestos fibre and copper in Labrador, and copper bearing and lead and zinc mineralization in Newfoundland.

Jubilee Celebrations

Aluminium was first produced at Dolgarrog in 1908, but it was not until December 1909 that the present **Aluminium Corporation Limited** was formed. Yesterday (Thursday), a special Golden Jubilee Reception Day was held at Dolgarrog as part of the company's celebrations of this event.

The early years, during which the hydro-electric scheme was being developed, were a hard struggle for the company due to shortage of capital and the low price of aluminium. Just prior to the first world war most of the aluminium produced at Dolgarrog, and surplus carbon anodes, were sold to Germany, from which country alumina was purchased. During the war, Dolgarrog became a controlled establishment under military guard against "saboteurs and infernal machines." A small rolling plant was set up in 1916 so that the Corporation became rollers of their own metal, with the modest production capacity of 3-4 tons per week.

After the 1914-1918 war, the company's financial position showed some improvement, and a development programme was put in hand which included additions to the rolling mill and furnace room and the building of a further 100 houses for employees in Dolgarrog village. This programme suffered a severe setback when, in 1925, the dam on Llyn Eigiau burst, causing the loss of sixteen lives and burying the works in six feet of debris. In 1926, the Corporation became associated with a new company, known as The International Aluminium Company, Limited, and its Norwegian subsidiary, A/S Haugvik Smelteverk, from whom ingot metal for rolling was purchased at a favourable price. Three years later it became necessary to dispose of the hydro-electric plant to the North Wales Power Company, who agreed to supply power at a special rate for a period of twenty years. Further additions were then made to the rolling plant, raising the capacity to 3,000 tons per annum. In 1931, the Alliance Aluminium Compagnie, an international company formed to control production of aluminium in Europe, obtained a majority of the shares in the corporation.

During the second world war, Dolgarrog was working round the clock, mainly producing sheet for aircraft, and at this stage the annual output rose to over 5,000 tons. By 1944, large supplies of Canadian ingot metal were available, so the furnace room was closed down due to the very high cost of power, and production of ingot ceased.

In 1949, **The British Aluminium Company, Limited,** took over Alliance Aluminium Compagnie's holding in the corporation and immediately started to modernize and improve the rolling mills and village properties.

The latest development started three years ago, when it was decided to replace the old 3-high hot breaking down mill, which was the limiting factor to output, with a modern 2-high reversing hot mill equipped with up-to-date handling facilities and coiling equipment. When full capacity working is reached, the mill will be producing up to five tons per hour of hot rolled slabs.

The new hot mill has brought semi-automation to Dolgarrog and has opened the way for future development and increased employment.

There is a strong community spirit at Dolgarrog. Most of the houses in the village are owned by the company and occupied by employees. Many people in the village have worked for the company for a long time, some since its very earliest days, and there are about 100 members of the Thirty Year Club. The factory itself occupies 211,000 square feet of floor space on a 26 acre site and is laid out to blend with the character of the Conway Valley. T.I./Reynolds recently acquired control of the British Aluminium Group, of which Aluminium Corporation Limited is an independent subsidiary.

Visit to Research Laboratories

On Monday last, members of the Press were invited to visit the **Tube Investments Research Laboratories,** Hinxton Hall, near Cambridge. These laboratories are part of the Research and Development Division of Tube Investments Limited, the other four establishments being located at Walsall and Birmingham.

Hinxton Hall was acquired in 1954 as a centre for the company's research laboratories, which are intended both to provide the scientific basis for development work and to contribute to fundamental research in scientific fields of major interest to T.I. Research work was started in Hinxton Hall in the year of its acquisition, and during 1956-58 a new laboratory was built nearby and most of the research activities have now been transferred to this building.

The laboratory was designed mainly for work in the solid state physics field, but provision has been made for specialist facilities in other fields. The total area is 32,500 ft^2 on three floors. A lecture theatre is also included in the building. The library, conference rooms, administrative and technical service accommodation, remain in the old hall. The main workshops are housed in converted outbuildings nearby. The total staff at the laboratories is about 150.

Among the items of research shown to the visitors this week were the following: Electron microscopy of thin metal films, Mechanical properties of non-metallic "Whisker" crystals, Lubrication and wear, Welding studies, Ultrasonic welding, Influence of impurities on metal deformation (two basic studies here were shown —steel and beryllium), Corrosion studies, Application of high energy irradiation, Research related to tube making, and several new instruments.

Eire Copper Exports

Copper ore and concentrates appear as a new item in the Eire trade returns for the first half of the current year, totalling 278,560 cwt. valued at £400,659. West Germany was the largest recipient, taking 120,200 cwt., valued at £167,947, while Sweden received 70,200 cwt. (£106,000) and Spain 55,460 cwt. (£83,556).

The bulk of the raw copper, which was smelted on the Continent, came from Saint Patrick Mines Ltd., in Avoca, County Wicklow, the only copper mines at present in production in the Republic.

Japanese Rolled Copper

According to the Japan Brass Makers' Association, July production of rolled copper products reached 15,000 metric tons for the first time this year. July deliveries on the local market were also in the region of 15,000 tons.

A spokesman for the Association said that with demand continually increasing for rolled copper products in the past few months, it had been decided that no production target would be set after September. A production target of 14,200 metric tons a month was originally set for July/September this year. The Japanese Ministry of Trade has announced that production of rolled copper products for the 1959 financial year ending March, 1960, would be raised to 184,000 metric tons. Last year's output totalled 177,100 metric tons.

Men and Metals

From Benjamin Electric Limited it is learned that **Mr. T. R. Manderson** has been appointed southern area manager for the company.

A director of Electropol Processing Ltd., and managing director of Electropol Ltd., **Mr. P. Allan Charlesworth,** B.Sc., A.R.I.C., is making a tour of the United States, visiting New York, Philadelphia, Columbus, Los Angeles, San Francisco, Cleveland, Milwaukee and Waukegan.

Elected President of the Purchasing Officers' Association for 1959-60, **Mr. A. H. Thomas** is associated with British Belting and Asbestos Limited.

It has been announced that **Mr. Maxwell I. Freeman,** B.Sc., A.R.C.S., A.M.I.Chem.E., has been appointed a director of the Consolidated Zinc Corporation.

It is understood that **Mr. S. W. F. Patching,** formerly head of the Mineral Dressing Group for the Atomic Energy Authority at Harwell, has joined the Baker Perkins company as manager of that company's new processing department.

In succession to **Mr. G. E. V. Thompson,** who is retiring, **Mr. M. Mothio,** previously sales manager of the London Division of Shell-Mex and B.P., has been appointed manager of the division. **Mr. G. V. Watson** and **Mr. T. Glynn Jones** have been appointed sales manager of the division.

Laycock Engineering, a member of the Birfield group, have appointed **Mr. Kenneth Walker** and **Mr. Eric Thompson** managing directors of the company.

Forthcoming Meetings

October 3—Institute of Metal Finishing. North-West Branch. Engineers' Club, Albert Sq., Manchester. "Control and New Development in Chrome Plating." Speaker to be announced. 7.30 p.m.

October 6—Institute of Metal Finishing. Midland Branch. Imperial Hotel, Birmingham. Symposium on Fifth International Conference. Talks by members who were present at Detroit. 2 p.m.

October 9—Institute of Metal Finishing. South-West Branch. Royal Hotel, Bristol. Annual Dinner and Dance.

Metal Market News

BUSINESS on the Metal Exchange last week was rather below average in turnover, but not lacking in interest. The tone was on the whole very steady, and in copper firm with appreciable gains on balance. Disturbing factors, apart from the unsettling influence of the forthcoming election, provided an uneasy background, but it is probable that semis manufacturers experienced quite a good week. The overall fluctuations in the prices of zinc, lead and tin were not great, and on the whole it was a period of reasonable stability. Copper led off with a reduction of 1,850 tons in L.M.E. stocks to 12,813 tons, and it is, therefore, not surprising that the contango was reduced from 30s. to no more than 10s. by the end of the week. It would appear that buyers in the U.S.A. are still seeking to secure copper in Europe in spite of the uncertainties surrounding the possibility of a longshoremen's strike. It is thought that by this time many thousands of tons of copper, much of it probably in the form of wirebars, have been shipped to the United States. This must mean that stocks of marginal copper on this side have been considerably reduced, and should trouble begin at any other centre of production the situation might well be serious. In standard copper, the tonnage changing hands last week amounted to nearly 8,000 tons, the close being £229 5s. 0d. cash and £229 15s. 0d. three months. This was 5s. below the price at midday, which was the highest for the week. On balance, cash gained £4 5s. 0d. and three months £3 5s. 0d.

During the week, the London copper market was a good deal under the influence of events in the United States. On Wednesday it became known that the Kennecott Copper Corporation would resume negotiations with the Mine Union at Salt Lake City on October 1. This was naturally a bear point for the market, but the effect was not very noticeable. On the following day the tone was firm in view of the favourable American fabricator statistics, and these August figures, coupled with the improvement in Whittington Avenue, gave the New York Commodity Market a boost. This, in turn, helped last Friday's market here, particularly as a modest amount of consumer buying was reported. So, as already mentioned, the close was firm and the outlook favours higher values. One reason for the firmness of the standard market last Friday was the report that the negotiations between the employers and the workers at the Braden property had reached a somewhat critical stage inasmuch as the ballot had revealed a majority in favour of a strike on October 1. In the meanwhile, it would appear that the employers are in touch with the Chilean Government with a view to preventing a stoppage. Should, unfortunately, a strike occur in Chile, the effect on the London standard copper market would be very marked.

In zinc, the midday market on Monday at the beginning of last week registered a low point at £84 15s. 0d. for the current month and £84 for December. Before the afternoon session opened, however, it was known that the American price was up by 1 cent to 12 cents, and on the strength of this there was an advance of about £2. The higher level was maintained and, after a turnover of less than 4,000 tons, the market closed virtually unchanged at £86 September and £85 December. Trading in lead was rather more active than in zinc, for some 6,500 tons changed hands, the tendency being rather easier. In midweek, September metal stood at £69 12s. 6d. and December at £71, but the close was £70 current month and £71 5s. 0d. forward, a fall of 15s. in both positions. The tin market was dull, with a turnover of 465 tons. Cash was unchanged at £793 10s. 0d., but three months lost 30s. at £793. Stocks increased by 23 tons to 8,080 tons.

New York

Over the week-end Commodity Exchange copper was firmer on covering and new buying in a fair volume. Later, however, profit-taking pared the gain. Traders said that dealers' copper was firmer. Consumers were paying $33\frac{3}{4}$ cents/lb. for immediate delivery. Offerings were reported subsequently at 34 cents, but in view of the late decline in Commodity Exchange buying, interest at these levels quietened. Tin was firmer in nearbys but quiet, reflecting a possible dock strike. Lead and zinc were quiet. At the close, tin was quiet and steady. Lead, zinc and copper were unchanged.

U.S. foundries and other aluminium users will recover a total of more than 900 million lb. of scrap aluminium in 1959, with an annual salvage rate of 1·5 thousand million lb. by 1965, it has been predicted by the Aluminium Smelters' Research Institute, Chicago. The estimate for this year includes approximately 700 million lb. of "new" or generated scrap, and 200 million lb. of obsolescent, for a total of 900 million lb.—almost double the 1950 supply.

Birmingham

The outlook in the metal-using industries in Birmingham is favourable. Gradual expansion has taken place in September, and it is believed that this will continue throughout the last quarter. The car boom continues and the commercial vehicle trade, which had a quiet spell, has made a good recovery since purchase tax on vehicles was abolished in April. With a larger volume of goods to be moved in industry, sales are expected to increase still further. The building industry, favoured by the long spell of fine weather, is very active, and there is a good market for pressings and castings, and other fittings used in the trade. Makers of domestic equipment for heating and cooking are well employed.

Prospects in the iron and steel industry are such that full employment is assured in many works for some months ahead. Activity in the lighter engineering groups has brought a bigger demand for raw material. Improvement has started in the heavy structural department, and enquiries for joists and heavy sections are more numerous. There is plenty of work amongst ironfounders producing castings for the motor trade. Current output of pig iron is being taken up. The steel sheet mills are under pressure to keep the motor trade supplied. More work has reached the tube mills and there is a bigger demand for strip.

Jamaica

It was stated recently in Kingston by Dr. D. A. Bryn Davies, chairman and managing director of Alumina Jamaica Limited, that his company's £15 million new plant at Ewarton will begin production of alumina towards the end of the year. He said that this was possible because of a "continuing though gradual improvement in the international aluminium industry, on which the company's markets for alumina depend". The plant should be completed in time, and if market conditions continued to be favourable he anticipated that full production of 250,000 tons of alumina should be reached by the second half of 1961.

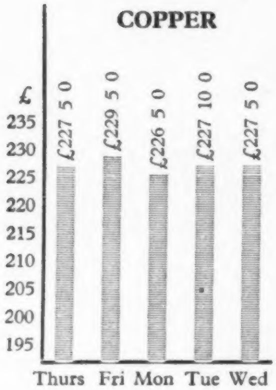
Dr. Davies said that the cost of the Ewarton plant was approximately £15 million, of which £6 million was being spent in Jamaica on construction, wages and services, and £9 million in Britain, Canada and the United States on machinery, equipment and materials. Completion of Ewarton plant will bring the company's total investment in the development of Jamaica's bauxite industry to £40 million.

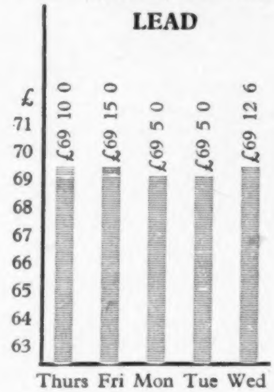
Meanwhile, the Aluminum Company of America (ALCOA) is prospecting in nearby Clarendon, over a 50 square mile area in an intensive search for bauxite. ALCOA are agents for Caribex Limited, a subsidiary of American Metal Climax Incorporated, which was granted a licence by the Jamaican Government in 1957 to prospect. Their surveys and tests indicated that there is sufficient bauxite in the area to build Jamaica's fifth alumina plant.

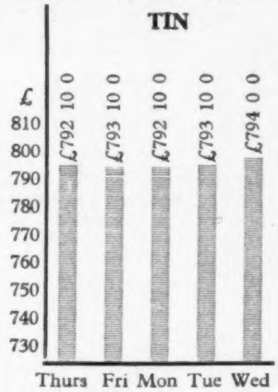
Non-Ferrous Metal Prices

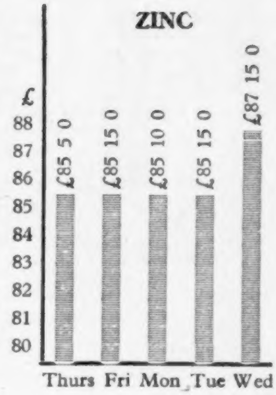
London Metal Exchange

Thursday 24 September to Wednesday 30 September 1959









Primary Metals

All prices quoted are those available at 2 p.m. 30/9/59

		£	s.	d.
Aluminium Ingots....	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%..	„	190	0	0
Antimony Oxide......	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder........	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%......	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite.... per unit			—	
Copper H.C. Electro..	ton	227	5	0
Fire Refined 99·70%	„	226	0	0
Fire Refined 99·50%	„	225	0	0

		£	s.	d.
Copper Sulphate	ton	74	10	0
Germanium	grm.		—	
Gold	oz.	12	10	8½
Indium	„		10	0
Iridium..............	„	24	0	0
Lanthanum	grm.		15	0
Lead English..........	ton	69	12	6
Magnesium Ingots....	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4......	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal....	ton	245	0	0
Mercury	flask	71	10	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%..........	ton		nom.	
Silver Spot Bars......	oz.		6	7
Tellurium	lb.		15	0
Tin	ton	794	0	0
***Zinc**				
Electrolytic..........	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	86	11	3
Dust 95/97%........	„	114	0	0
Dust 98/99%........	„	120	0	0
Granulated 99+% ..	„	111	11	3
Granulated 99·99+%	„	125	10	0

* *Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏£/ton	Canada c/lb	≏£/ton	France fr/kg	≏£/ton	Italy lire/kg	≏£/ton	Switzerland fr/kg	≏£/ton	United States c/lb	≏£/ton
Aluminium			22.50	185 17 6	224	168 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					230	171 10	445	262 10			29.00	232 0
Cadmium					1.300	975 0					120.00	960 0
Copper												
Crude												
Wire bars 99.9							455	268 10				
Electrolytic	31.50	231 17 6	29.00	238 12 6	315	236 5 6			2.65	225 5	30.00	240 0
Lead			10.75	88 12 6	101	75 15	162	95 12 6	.87	73 17 6	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	111.00	817 2 6			1,124	843 0	1,500	885 0	9.70	824 12 6	102.75	822 0
Zinc												
Prime western			11.75	97 0 0								
Highgrade99.95			12.35	102 0 0								
Highgrade99.99			12.75	105 2 6								
Thermic					126.00	94 12 6						
Electrolytic					134.00	99 12 6	192	113 5	1.05	89 2 6	13.50	108 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 30/9/59

Aluminium Alloy (Virgin)

		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10....	„	221	0	0
B.S. 1490 L.M.11....	„	215	0	0
B.S. 1490 L.M.12....	„	223	0	0
B.S. 1490 L.M.13....	„	216	0	0
B.S. 1490 L.M.14....	„	224	0	0
B.S. 1490 L.M.15....	„	210	0	0
B.S. 1490 L.M.16....	„	206	0	0
B.S. 1490 L.M.18....	„	203	0	0
B.S. 1490 L.M.22....	„	210	0	0

Aluminium Alloys (Secondary)

		£	s.	d.
B.S. 1490 L.M.1	ton	152	0	0
B.S. 1490 L.M.2	„	162	0	0
B.S. 1490 L.M.4	„	178	0	0
B.S. 1490 L.M.6	„	188	0	0

***Aluminium Bronze**

		£	s.	d.
BSS 1400 AB.1......	ton	232	0	0
BSS 1400 AB.2......	„	244	0	0

***Brass**

		£	s.	d.
BSS 1400-B3 65/35 ..	ton	152	0	0
BSS 249	„	—		
BSS 1400-B6 85/15 ..	„	198	0	0

***Gunmetal**

		£	s.	d.
R.C.H. 3/4% ton	„	—		
(85/5/5/5) LG2	„	188	0	0
(86/7/5/2) LG3	„	197	0	0
(88/10/2/1)	„	236	0	0
(88/10/2/½)	„	248	0	0

***Manganese Bronze**

		£	s.	d.
BSS 1400 HTB1....	„	183	0	0
BSS 1400 HTB2....	„	197	0	0
BSS 1400 HTB3....	„	212	0	0

Nickel Silver

		£	s.	d.
Casting Quality 12%	„	225	0	0
„ „ 16%	„	232	0	0
„ „ 18%	„	245	0	0

***Phosphor Bronze**

		£	s.	d.
B.S. 1400 P.B.1.(A.I.D. released)	„	284	0	0
B.S. 1400 L.P.B.1	„	208	0	0

**Average prices for the last week-end.*

Phosphor Copper

		£	s.	d.
10%	ton	246	0	0
15%	„	248	0	0

Phosphor Tin

		£	s.	d.
5%	..	—		

Silicon Bronze

		£	s.	d.
BSS 1400-SB1	„	238	0	0

Solder, soft, BSS 219

		£	s.	d.
Grade C Tinmans....	„	367	5	0
Grade D Plumbers..	„	294	15	0
Grade M	„	403	5	0

Solder, Brazing, BSS 1845

		£	s.	d.
Type 8 (Granulated)	lb.	—		
Type 9 „	„	—		

Zinc Alloys

		£	s.	d.
Mazak III	ton	118	15	0
Mazak V	„	122	15	0
Kayem	„	128	15	0
Kayem II	„	134	15	0
Sodium-Zinc	lb.		2	7½

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium

		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8¼
Sheet 18 S.W.G.	„		2	10¼
Sheet 24 S.W.G.	„		3	1¼
Strip 10 S.W.G.	„		2	8¼
Strip 18 S.W.G.	„		2	9¼
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2¼
Circles 18 S.W.G.	„		3	1¼
Circles 12 S.W.G.	„		3	0¼
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

Aluminium Alloys

		£	s.	d.
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled......	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated..	„		3	6½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½

Brass

		£	s.	d.
Tubes..............	„		1	9¾
Brazed Tubes........	„		2	11¾
Drawn Strip Sections	„		3	0½
Sheet	ton	196	0	0
Strip	„	196	0	0
Extruded Bar........	lb.		2	0½
Extruded Bar (Pure Metal Basis)	„		—	

Brass

		£	s.	d.
Condenser Plate (Yellow Metal)	ton	189	0	0
Condenser Plate (Naval Brass)	„	201	0	0
Wire	lb.		2	7⅞

Beryllium Copper

		£	s.	d.
Strip	„	1	4	11
Rod................	„	1	1	6
Wire	„	1	4	9

Copper

		£	s.	d.
Tubes	lb.		2	2⅝
Sheet	ton	256	0	0
Strip	„	256	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	279	15	0

Cupro Nickel

		£	s.	d.
Tubes 70/30	lb.		3	6⅝

Lead

		£	s.	d.
Pipes (London)	ton	111	5	0
Sheet (London)	„	109	0	0
Tellurium Lead	„	£6 extra		

Nickel Silver

		£	s.	d.
Sheet and Strip 7% ..	lb.		3	7¾
Wire 10%	„		4	2⅝

Phosphor Bronze

		£	s.	d.
Wire	„		4	0

Titanium (1,000 lb. lots)

Billet 4½" to 18" dia...	lb.	54/-	55/-
Rod ¼" to 4" dia.	„	95/-	62/-
Wire ·036" – ·232" dia.	„	167/-	110/-
Strip ·003" to ·048" ..	„	200/-	75/-
Sheet 8'×2'. 20 gauge	„	85/-	
Tube, representative average gauge......	„	300/-	
Extrusions	„	105/-	

Zinc

		£	s.	d.
Sheet	ton	120	15	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 29/9/59.

Aluminium

	£
New Cuttings	147
Old Rolled	129
Segregated Turnings	102

Brass

	£
Cuttings	158
Rod Ends	145
Heavy Yellow	120
Light	114
Rolled	150
Collected Scrap	116
Turnings	138

Copper

	£
Wire	206
Firebox, cut up	198
Heavy	193
Light	186
Cuttings	206
Turnings	188
Braziery	157

Gunmetal

	£
Gear Wheels	171
Admiralty..............	171
Commercial	155
Turnings	150

Lead

	£
Scrap	60

Nickel

	£
Cuttings	—
Anodes	550

Phosphor Bronze

	£
Scrap	155
Turnings	150

Zinc

	£
Remelted	76
Cuttings	62
Old Zinc	41

Financial News

Capper Pass and Son

Group trading profit year to March 31, 1959, including gain on metal price rise, £570,817 (£258,720, including loss on lower metal prices), net profit £208,301 (£26,932) and dividends 10 (8) per cent. Total net assets £3,514,125 (£3,276,725) and net current assets £2,504,781 (£2,114,750), including investments £276,819 (nil) value £277,197, tax certificates £100,000 (nil), and cash £623,422 (£13,904 and overdrafts £239,916). Commitments £45,000.

Billiton Tin

At the annual meeting of the Billiton Tin Company last week it was stated that the dividend for 1959 was not expected to be lower than previous years, judging by results this year. The meeting approved the 1958 dividend of 15 per cent.

In its review, the Board said more plans were being studied to extend the company's interests in the chemical industry. Mining operations in Canada had so far been unsuccessful. The Board expected tin prices to rise in the next ten years. As a result, the Kamativi tin mines, in which Billiton had an interest, would become remunerative. In Surinam, bauxite production was expected to rise gradually to 1,250,000 tons annually. The Board added that aluminium sales prospects for the company in Surinam were expected to improve next year.

Albright and Wilson Ltd.

At an extraordinary general meeting of the company, held last week, resolutions were passed for the increase of the authorized capital of the company from £9 million to £12 million, and for the issue of one fully-paid 5s. ordinary share (to be converted into stock) for every four 5s. ordinary stock units held by stockholders on the register on September 4 last.

Delta Metal Company

It is reported that this company is maintaining its interim with a payment of 5 per cent on capital doubled by a scrip issue. The directors state that group profits to date exceed those for the corresponding period of last year, without taking into account the two new subsidiaries recently acquired—E. P. Jenks and Alfred Case and Company—whose profits prior to acquisition will in any case be treated as capital.

Le Grand, Sutcliffe and Gell

According to City news the offer by Stone-Platt Industries to acquire all the preference shares of Le Grand, Sutcliffe and Gell, has been successful. It is understood that the offer of 20s. cash per share has been accepted by some 95 per cent of shareholders and has become unconditional.

Aluminum Company of America

Third quarter earnings of Aluminum Company of America should be better than the 62 cents per share of a year ago, but not as good as the 83 cents in the second quarter of 1959, it is estimated by the company's vice president and treasurer, Mr. Edward B. Wilbur. He said the current steel strike clouded any fourth quarter forecast. However, he noted that a previous prediction by president Frank Magee (prior to the steel strike) that earnings for the full year would exceed the 1·96 dollars per share level of 1958, had "a great opportunity of being correct." Mr. Wilbur said he did not know of any contemplated stock split by ALCOA, but would be surprised if one occurred. He would also be surprised if directors changed the current quarterly dividend rate of 30 cents.

Devaluation in Uruguay

Latest news from Montevideo is that a Government Bill devaluing the Uruguayan currency, discontinuing the multiple exchange system and simplifying trade regulations, has been tabled in Congress for early consideration. The present official parity of 1·519 pesos to the dollar will be brought to around 6·50. This is still a long way from the free market rate, which was indicated at 10·84 to 10·94 pesos. The move, basically designed to streamline the obsolete exchange system, also constitutes a preliminary step towards obtaining financial aid from the International Monetary Fund and other international agencies. This aid would be used to implement a comprehensive recovery programme similar to that of Argentina.

Theoretically, the Bill seeks to establish freedom of trade and exchange, but the Government retains the right to regulate imports and compel exporters to negotiate foreign earnings at the Central Bank. In order to alleviate the impact of the devaluation on local living standards, the Bill authorizes the Government to subsidise essential foodstuffs and services through export levies.

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for June, 1959, have been issued by the Ministry of Supply as follows (in long tons):—

Virgin Aluminium	
Production	1,987
Imports	29,294
Despatches to consumers	30,050
Secondary Aluminium	
Production	10,598
Virgin content of above	822
Despatches (including virgin content)	10,772
Scrap	
Arisings	13,765
Estimated quantity of metal recoverable	9,768
Consumption by:	
(a) Secondary smelters	12,701
(b) Other uses	1,206
Despatches of wrought and cast products	
Sheet, strip and circles	13,959
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	3,206
(b) Tubes (i) extruded	267
(ii) cold drawn	612
(c) (i) Wire	2,044
(ii) Hot rolled rod (not included in (c) (i)	60
Forgings	323
Castings: (a) Sand	1,755
(b) Gravity die	4,316
(c) Pressure die	1,906
Foil	2,137
Paste	357
Magnesium Fabrication	
Sheet and strip	5
Extrusions	80
Castings	174
Forgings	6

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£205.17.6)	235
Heavy copper	(£201.10.0)	230
Light copper	(£170.17.6)	195
Heavy brass	(£118.5.0)	135
Light brass	(£91.17.6)	105
Soft lead scrap	(£56.0.0)	64
Zinc scrap	(£38.12.6)	44
Used aluminium unsorted	(£105.2.6)	120
France (francs per kilo):		
Electrolytic copper scrap	(£198.15.0)	260
Heavy copper	(£198.15.0)	260
No. 1 copper wire	(£183.15.0)	240
Brass rod ends	(£127.12.6)	170
Zinc castings	(£51.0.0)	68
Lead	(£69.0.0)	92
Aluminium	(£129.12.6)	173
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£200.15.0)	340
Aluminium copper alloy	(£135.17.6)	240
Lead, soft, first quality	(£79.0.0)	134
Lead, battery plates	(£44.5.0)	75
Copper, first grade	(£221.5.0)	375
Copper, second grade	(£209.10.0)	355
Bronze, first quality machinery	(£203.2.6)	345
Bronze, commercial gunmetal	(£174.10.0)	295
Brass, heavy	(£147.12.6)	250
Brass, light	(£237.17.6)	225
Brass, bar turnings	(£135.17.6)	230
New zinc sheet clippings	(£65.0.0)	110
Old zinc	(£50.2.6)	85

LIGHT METALS STATISTICS IN JAPAN

(April, 1959)

Classification	Production	Shipment	Stock	Export
Alumina	22,488	27,355	11,657	12,138
Aluminium				
Primary	8,113	8,477	1,995	0
Secondary	2,485	2,561	283	0
Rolled Products	7,481	7,277	1,820	691
Electric Wire	979	751	1,080	306
Sheet Products	1,739	1,683	1,284	119
Castings	1,981	—	—	—
Die-Castings	1,203	—	—	—
Forgings	20	—	—	—
Powder	—	—	—	—
Primary Aluminium (May)	8,512	8,797	1,710	2
Sponge Titanium	2,932	3,052	1,764	1,26
Magnesium	119	158	17	0
Secondary	232	248	2[illegible]	0

THE STOCK EXCHANGE

Market Turned Quieter And Fairly Widespread Reaction Occurred, Especially Among Steels

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 28 SEPTEMBER	+ RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	27/–	+10½d.	9	9	6 13 3	27/4½	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3		4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	60/4½	—7½d.	15	15	4 19 6	63/6	54/–	58/9	46/6
1,613,280	1	Birfield	58/6		15	15	5 2 6	60/–	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	82/–	—1/–	17½	17½	4 5 3	83/–	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	47/3	—9d.	11	10	4 13 0	48/3	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/–		5	5	6 5 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	18/10½		6	6	6 7 0	18/10½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	34/6		10	10	5 16 0	34/6	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	20/6	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/6		6	6	5 17 6	20/7½	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	51/9	—1/–	12½	12½	4 16 6	57/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	64/6	—2/–	10	10	3 2 0	66/9	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	14/–	—6d.	25 + *2½C‡	25	4 9 3	16/–	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	2/3	—3d.	12½	25	5 11 0	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	26/3		10	10	7 12 6	27/–	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	17/–		6	6	7 1 3	16/9	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/–		15	20	10 0 0	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	63/9	—6d.	15	18¾	4 14 0	69/3	59/–	65/3	41/–
1,509,528	1	Davy & United	84/–	+2/6	30‡	20	3 11 6	84/–	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	17/3	—9d.	31‡	30	4 9 9	18/–	12/–	25/–	17/7½
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	53/6	—1/6	15	12½	5 12 3	57/6	36/7½	38/–	22/9
750,000	1	Evered & Co.	35/9		10§	15D	5 12 0	35/9	30/–	30/–	26/–
18,000,000	Stk. (£1)	General Electric Co.	38/9	—1/3	10	10P	5 3 3	40/3	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	39/3	+1/6	20	20	5 2 0	40/–	32/6	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	64/4½	+10½d.	16½	15	5 2 6	66/6	63/6	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	8/–	—3d.	11½	11½	7 3 9	9/3	6/7½	8/3	5/–
1,750,000	5/–	Glynwed Tubes	21/3	—1/–	20 ¶	20	4 14 0	23/–	16/4½	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	40/3		13‖	18D	3 4 6	40/3	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	105/–		30	20	5 14 3	108/3	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	19/10½		*17½	*15	4 8 0	20/–	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6		7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/–	Heenan Group	10/–		10	10‡	5 0 0	10/6	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	44/–	+1/9	12 DZ	10	3 12 9	46/4½	33/9	39/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	16/6	—7½d.	5	5	6 1 3	17/9	16/–	17/1½	16/–
14,584,025	**	International Nickel	171½	+½	$2.60	$3.75	2 17 0	187¾	154½	169	132¾
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	40/–	—2/–	12D	10	4 0 0	44/3	29/7½	47/–	36/6
600,000	10/–	Keith, Blackman	31/3		17½E	15	4 7 0	31/3	25/–	28/9	15/–
320,000	4/–	London Aluminium	6/4½		10	10	6 5 6	6/9	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	44/6	—6d.	15	15	6 14 9	45/–	41/–	45/–	32/–
1,530,024	1	Ditto A Ord.	43/—		15	15	6 19 6	43/6	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	15/–	+6d.	20⅝	20	6 19 9	16/3	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	60/3	—3/–	11	11	3 13 0	63/3	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	10/9	—6d.	50	50	9 6 0	12/3	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	28/–		10	10	7 2 9	28/–	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	80/–		6	6	7 10 0	75/6	69/–	83/6	69/–
3,705,670	Stk. (£1)	Morgan Crucible A	57/–	—6d.	10ɸ	10	3 10 2	58/6	43/6	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/–		5½	5½	6 2 3	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	49/3	—3/–	15	17½	6 1 9	52/3	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	12/–		10R	10	3 2 6	12/–	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	41/–		25	20	6 2 0	41/–	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Serck	23/9	+1½d.	15	17½	3 3 3	24/–	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	50/6	+3d.	15	15	5 18 9	53/6	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/9		5½	5½	6 4 0	18/–	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	92/6	—1/6	17½	15	3 15 9	94/3	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	27/4½	—1/1½	10	10	7 6 0	37/–	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 9	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6		*5	*5	6 12 9A	22/7½	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	100/–	+1/–	20	15	4 0 0	101/–	83/–	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	48/6	—6d.	10	10	4 2 6	49/–	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	9/9		30	25	6 3 0	10/6	8/8½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	28/6	—6d.	27½	27½	4 16 6	32/3	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	6/7½		20	20	7 11 0	7/1½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9		6	6	8 14 9	13/9	13/6	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/3	+1½d.	27	40D	8 6 0	3/9	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. ¶ Interim since increased from 10% to 12%. ɸ And proposed 40% capitalized issue. Z Interim since increased.

D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UNION CARBIDE can now supply a number of the rarer metals, many of which are available in a very high purity grade

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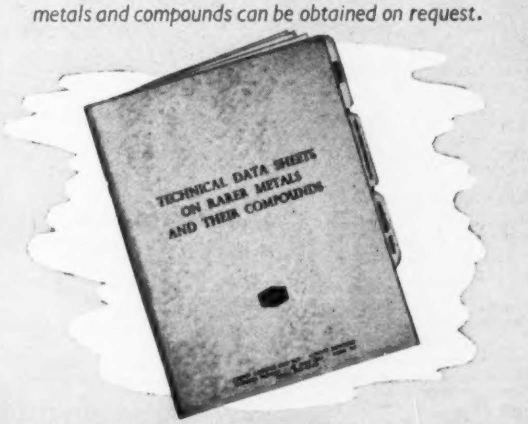
Over 70 compounds of the rarer metals are available and include oxides, nitrides, borides, carbides, chlorides, phosphides, sulphides, phosphates, selenides, acetylacetonates and carbonyls.

CATALOGUES OF DATA SHEETS

giving the composition and properties of the metals and compounds can be obtained on request.



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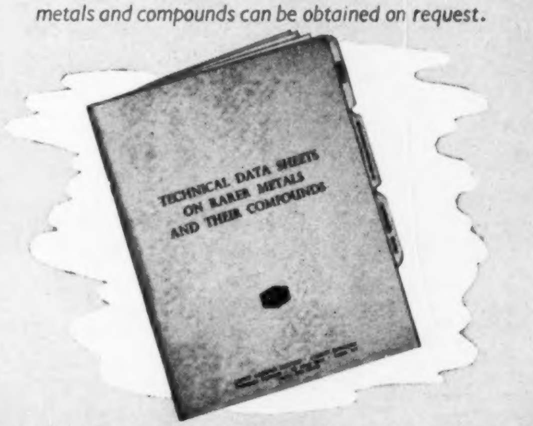

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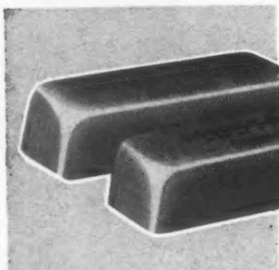

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